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THE NATIONAL ELECTRICAL EXPOSITION.

Judging from the great demand for space and the active interest now being taken in the coming National Electrical Exposition, which is to be held in New York City during the month of May, the most sanguine expectations of those primarily interested in its success are likely to be exceeded. There is every reason to believe that in the number and quality of the exhibits the exposition will prove a close rival to the electrical exhibit at the World's Fair in 1893. But however promising present prospects appear, the ultimate success of the enterprise depends upon the manner in which it is looked upon and received by the general public and to the degree with which the public can be made to appreciate the opportunities and advantages thus placed before them. The total indifference which has been from time to time manifested toward entertainments, amusements, plays, expositions and the like, indicates the uncertainty with which any new enterprise is launched forth. It will only be by judicious and extensive advertising that enthusiasm can be aroused and success in the exposition assured. New Yorkers, as a rule, are the most matter-of-fact people on the continent, and a New York audience is generally one of indifference and coldness. The spirit of enthusiasm which is so necessary and at the same time encouraging to the manager is generally in New York an uncertain and fluctuating factor. For these reasons, every effort should be made to induce those who live in the vicinity of New York to patronize the exposition, and to attain this end the efforts now being made for reduced fares deserve the co-operation of all and a hearty response from the railway officials. A partial list of the exhibitors who have secured space will be found in another column, and it is the intention of THE ELECTRICAL WORLD to give during the exposition a full account of the proceedings, the character of the exhibits, and items of interest to all of its many readers, and more especially to those who may not be so fortunate as to be able to attend.

WAVE-LENGTH OF RÖNTGEN RAYS.

In another column will be found a communication from Prof. Rowland, Mr. Carmichael and Mr. Briggs, in which, although they still maintain that the anode is the probable source of Röntgen says, they at the same time admit that its action is dependent upon the direct influence of the cathode discharge, thus arriving at the same conclusion as that expressed in our columns of last week, namely, that the anode may become a secondary source of radiance. Prof. Rowland in a separate communication makes the provisional statement that the wave-length of Röntgen rays cannot be greater than one-seven-millionth of a centimetre or one-seventh that of yellow light, thus placing them, on the supposition that they form a part of the spectrum, considerably beyond the ultra-violet thus far photographed by Schumann. Accepting this figure as approximately correct, it is not at all evident, as Prof. Rowland seems to infer, that waves of these dimensions are more quickly absorbed by matter than those of longer length. Although it is true experience shows that ultra-violet light undergoes more absorption than the longer light waves, it is still questionable as to the extent to which interpolation in this direction may be carried beyond experimental results. Waves of the dimension suggested by Prof. Rowland become, according to present theories, comparable with inter-molecular distances and if the amplitude of these waves is but a fraction of their wave-length, it seems reasonable to suppose that they might undergo less absorption than the violet waves of the visible spectrum. That is to say, the curve of penetration or absorption of these extremely short waves may possibly harmonize more closely

with the longer waves in the infra-red. Prof. Rowland leaves us in doubt as to just what he has measured, but we trust that the discussion during the meeting of the National Academy will prove a scource of valuable information not only on this but many other questions likely to arise. The action of diffused reflection is confirmed by Prof. Thomson in his communication on diffusion and opalescence, the results fully substantiating those obtained by Dr. Pupin. As Prof. Thomson states, this diffusive action is entirely different from that of ordinary reflection and this in turn raises the question, if ordinary reflection exists, as to the utility of the fluorescent screen for studying the characteristic features of the two phenomena. If the screen becomes uniformly illuminated when but a short distance from the tube, due to diffusive reflection, it is possible that this action so largely predominates that the effects which may exist due to ordinary reflection, are practically eliminated. By maintaining constant conditions in the excitation of the tube, it may prove true that better results are to be obtained by the use of the photographic plate.

DEFECTIVE INSULATING MATERIALS.

One of the greatest sources of trouble with which a manufacturer of electrical machinery has to contend is defective insulating materials. By this it is not intended to refer to materials that are of themselves inferior as insulators, but to materials which are rated high as insulators, and are therefore put to severe service. Too often these insulators fail by reason of a defective part, which usually consist of the inadvertent incorporation of a metallic substance into the compound. This particularly applies to pressed fibre, moulded mica, many compounds of asbestos, mica and other insulators formed under great pressure, and even true in the case with hard rubber and gutta percha. The foreign substances usually consist of fine particles of steel or brass in the form of chips or filings, and their presence indicates great carelessness in the manufacture of these insulating compounds. Sometimes a whole piece is of very low insulation resistance, because of the incorporation of fine particles of carbon into its texture. Some of the best insulators may be made by forming carefully selected scrap, and these insulators have become a necessity in electrical manufacturing, but the greatest care must be exercised in selecting the material of which they are made. Nothing will more effectively condemn an insulating material than its failure in an expensive machine, and the subsequent discovery of a cause like the one just indicated. There is really no excuse for the presence of steel particles in an insulating compound, for a powerful magnetic separator will remove them before the compound is formed. Brass, carbon and copper dust, which is common, can only be excluded by the scrupulous rejection of all materials that have been in proximity with these substances. Old commutator segments, collars and supports should never be used to form insulating compounds. Most of these formed compounds are excellent when well made, but it is false economy in the extreme to use inferior materials in their manufacture.

UNDERWRITERS' RULES.

We are inclined to look upon safety rules for electric installations in the same light as Herbert Spencer looks upon statute laws; they are merely provisional, subject to change from time to time, ultimately to be repealed. The fundamental theory of legislation is to pass such laws as are conducive to the public welfare, and as the general public is affected by electrical construction just to the extent to which such construction affects public safety, it follows that the risks of the insurance companies are, generally speaking, involved to the same extent, but it would be absurd to say that the two interests are identical. It is to the interest of the electrical profession to see that good work is performed and anything which will tend to raise the standard of construction must prove beneficial to all concerned. It is evident that it is within the province of the electrical engineer to decide as to what would be the best method to adopt under given conditions, and it is for this reason that the best results would probably be obtained, as has been suggested by Mr. Kennelly, by a proscriptive rather than a prescriptive set of rules. The methods and appliances to be avoided are generally known, and such should be forbidden, whereas, owing to rapid improvements, it is necessary to either change prescriptive rules or to overlook their rigid enforcement. The competent electrical engineer will act to the best of his ability, but if he be incompetent or dishonest, proscriptive rules are all that is necessary to prevent poor workmanship. Feeling, as we do, that such a radical change from existing conditions, however beneficial it might prove to be, is not likely to be adopted by the Underwriters' National Electric Association, an abstract is given in another column of the rules recently formulated by the Verband Deutscher Electrotechniker. The rules abstracted are such that differ more or less radically from those now used by the Underwriters' Association, and we trust that they may prove of some assistance to those who are now attempting to formulate a new code. It is obvious that but one code should exist in any particular district, and as the Underwriters' Association practically controls the situation, the code finally adopted must be that accepted by them. It is therefore ridiculous for any individual or organization to attempt to formulate a set of safety rules with the idea of antagonizing or forcing such upon those who are in a position to dictate. Inasmuch as the insurance interests favor the most careful and expensive construction, whereas the contractor must look to the most economical methods, it follows that their interests are more or less directly opposed, and for this reason it is perfectly proper for individuals or societies to extend to the underwriters their advice upon the technical points involved and to attempt by mutual agreement the adoption of a code which will be satisfactory to both interests.

Convention of the National Electric Light Association.

Arrangements have been made whereby delegates on the line of the Chicago & Alton road can use that road to Chicago and connect with the electrical special at that point for a fare and one third, on the certificate plan. This will enable the St. Louis delegates to leave that city at 11.30 p. m., reaching Chicago at 8.30 a. m. the following day, which will enable them to remain in the latter city until the time the electrical special leaves, namely, 5 p. m., Saturday, May 2.

New York Headquarters.—The Murray Hill Hotel, Forty-first Street and Park Avenue, has been selected as the hotel headquarters for delegates to the convention, May 5, 6, and 7.

It is stipulated, however, by the hotel management, that none of the guests make use of any part of the hotel for exhibition purposes, or display any signs or placards in the halls or corridors.

The exposition will be held two blocks from the hotel headquarters.

A Method of Measuring the Transparency of Substances to the Röntgen Rays.

In an article in *Science* of April 10, Prof. Robb suggests a method for the quantitative determination of the relative transparency of substances to the Röntgen rays, and the intensity of radiation. The method depends upon the fact that Röntgen rays have the power of dissipating the charge of a perfectly insulated electrified body, as established by Prof. J. J. Thompson and others. If the rays are allowed to fall upon a condenser it will be found that a very considerable diminution in its insulation resistance takes place, and that any charge which it may have had is gradually dissipated. The rate of discharge is directly dependent upon the length of exposure and intensity of the ray, the effect on the insulation immediately disappearing upon shielding the condenser from the action of the tube. By allowing the rays to pass through screens of various substances placed between the Crookes tube and condenser, the resulting leakage may be measured and a relative comparison made of their transparent qualities. This method, Prof. Robb believes, is capable of giving results much more quantitative in character than any that can be obtained by photographic methods.

Prof. Elihu Thomson at the Exposition.

In spite of many pressing engagements, Prof. Elihu Thomson is kindly preparing for the National Electrical Exposition a very interesting personal exhibit. He hopes to ship it to New York from New England in a few days. He has been requested by the management to include in it some of the working apparatus illustrative in many beautiful ways of the "repulsion phenomena," his classic investigation of which, some years ago, is well remembered by all electricians. An endeavor will also be made to secure a lecture from him during the exposition, as it is understood that he will be in New York at that time, and is one of the most successful lecturers of the day in explaining electricity popularly and clearly. A bust of Prof. Thomson is now being made by the Riccinilli Bros., of New York, under the direction of the sculptor, Mr. Robert Kraus, of Boston. It is expected to be finished by the end of the month, and the original has consented to its inclusion in the collection of busts and pictures that will adorn the space of the Loan and Historical Exhibit Committee.

The General Electric-Westinghouse Patent Arrangement.

The understanding arrived at some time ago by which the General Electric and Westinghouse Companies agreed to pool their patents, does not seem as yet to have had much effect so far as other and smaller electrical companies are concerned. While it was admitted that the discontinuance of so much litigation would be an excellent thing for all concerned, some feared that the two larger companies might go a step further and combine in some way to oppress their competitors. Others, however, thought that lightning was not likely to strike twice in the same place, and pointed out how unsatisfactory had been the experience of the General Electric when it undertook to do the entire electrical business of the country, based on the Edison incandescent lamp decision. The arrangement between the General Electric and the Westinghouse Companies does not extend beyond the matter of patents. While some regarded an amalgamation of the two corporations as not altogether an impossibility, those in a position to know say this is not contemplated.

Infringement Suit.

The Thomson-Houston Electric Company, of Boston, Mass., has commenced two suits in the United States Circuit Court, in Cleveland, O., against the Ohio Brass Company for the alleged infringement of two patents of the late Charles J. Van Depoele, owned by the company, on suspended switches and traveling contact for electric railways. The Thomson-Houston Company asks that the Ohio Brass Company pay over all gains that have accrued from the manufacture of these devices, and that the losses inflicted be repaired, and finally that it be enjoined and restrained from continuing the manufacture of these devices.

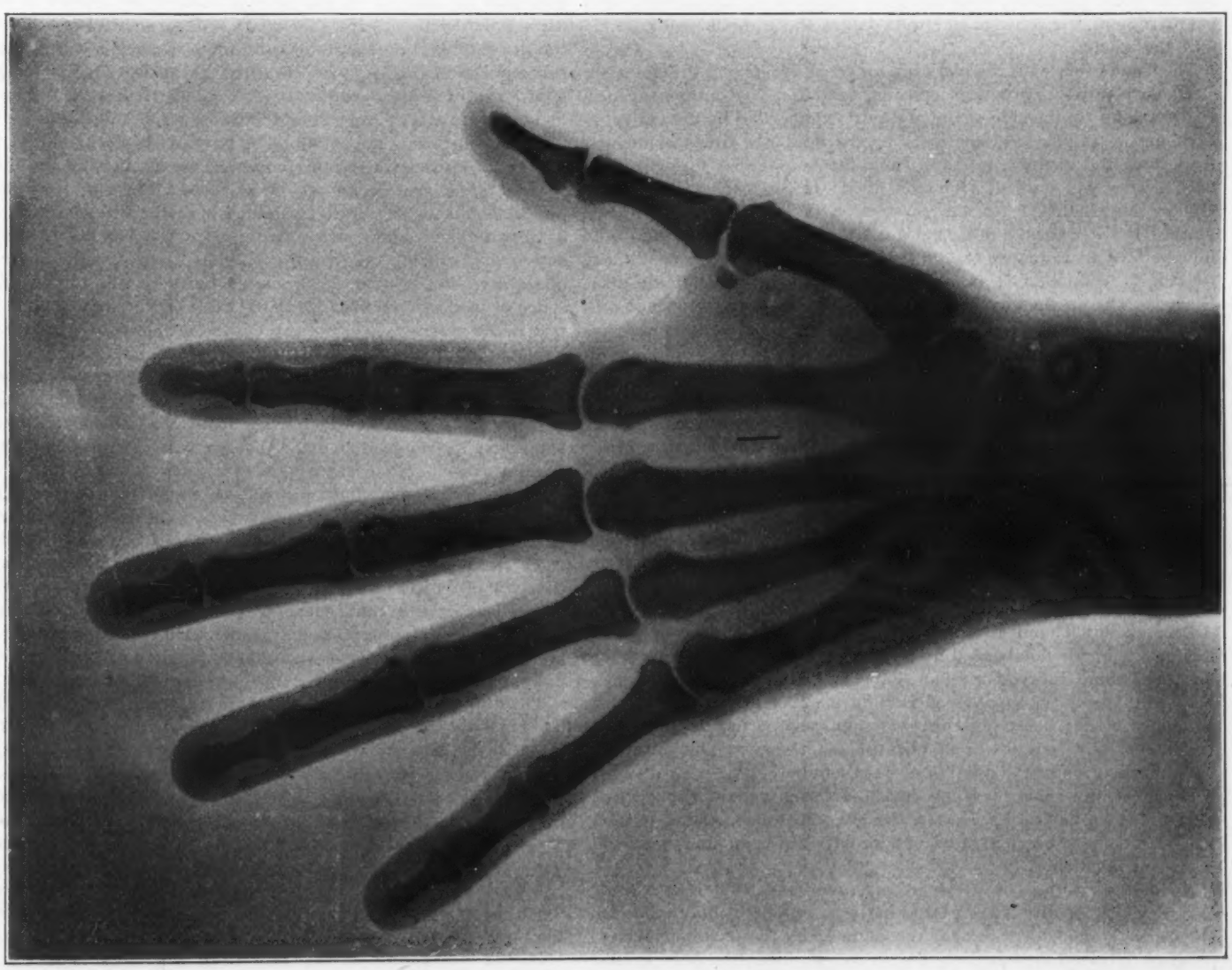
Electric Executions in Ohio.

The measure introduced into the Ohio Legislature providing for the execution in that State of murderers by electricity has become a law. The new law will take effect on July 1, next.

An Exceptionally Interesting Röntgen-Ray Picture.

Although the hand has been a favorite subject for Röntgen-ray pictures, and so many excellent results have already been obtained, yet the accompanying illustration is of particular interest, not only for its fine contrast shades, but more especially for the clearness with which it shows the carpal and meta-carpal bones and the eye of a broken needle, which has been embedded in the palm for some 20 years. The effect, however, has been considerably weakened in the process of reproduction.

The picture is one recently obtained by Mr. Herbert B. Shallenberger after the method which he first adopted in his experiments with Röntgen rays.



AN INTERESTING RADIOGRAPH.

Notes on Röntgen Rays.

BY H. A. ROWLAND, N. R. CARMICHAEL AND L. J. BRIGGS.

In the *American Journal of Science* for March we made a few notes of our researches on the Röntgen rays, reaching the provisional conclusion that the main source of the rays was at the *anode*, and that the cathode rays seemed to have nothing to do with the phenomena presented. A further study of the source of the rays in many other tubes has led us to modify this conclusion somewhat, for, while we still think the anode or its equivalent is the main source of the rays, yet we now have evidence in some of the tubes that it is necessary for the cathode rays to fall on the anode in order that the Röntgen rays may be formed.

In our tubes with a very high vacuum the other sources of rays are very faint indeed. We have never obtained any rays from the cathode except in one case, where undoubtedly there were electrical oscillations which made the cathode momentarily an anode. It can be readily proved that these oscillations always exist in the case of low resistance tubes, and these are probably the cause of many errors in estimating the source of the rays.

In some cases we have found very faint sources of rays as Röntgen found them, where the cathode rays struck the glass, but *not* where they struck a piece of platinum kept at nearly zero potential. On the anode theory this might be explained by the fact that the bombarding cathode rays, coming in periodical electrified showers, alternately raise and lower the potential of the glass, thus making it alternately an anode and cathode. In the case of the platinum, this could not occur to the same extent.

That feeble Röntgen rays emanate from *some* bodies when bombarded by the cathode rays, we are willing to admit, and, in fact, had long ago come to that conclusion. But we do not agree with Prof. Elihu Thomson's general conclusion that these rays are always given out from bombarded surfaces, as we have a tube, with platinum in the focus of a concave electrode, which emits no rays whatever from the platinum, even when the platinum is red hot from the bombardment, the concave electrode being the cathode and a third wire the anode.

The same tube, with the platinum made an *anode* and the concave electrode a cathode, produces a profuse radiation of Röntgen rays in all directions on the side of the platinum bombarded by the cathode rays, and *none* on the other side. In the first case we obtained no rays from the cathode, no rays from the bombarded surface, and only a very weak effect from the anode indeed, almost nothing. Hence the condition for the production of the rays seems to be neither the one nor the other but a combination of the two, and we now believe as far as we can yet see that the necessary condition for their production is an *anode* bombarded by the cathode discharge. The anode may be, however, an induced anode formed on the glass, and the cathode rays may vary a great deal and cease to present the usual appearance of cathode rays.

Thus, in the best tube that we have, originally made for showing that electricity will not pass through a vacuum, the main source is a point on the end of the anode, where a little point of light appears. Sometimes, across the little interval of one mm between the electrodes, a faint spark or arc crosses from one electrode to the other, and we think that the rays come out especially well under these conditions. Here the action of the bombarding cathode discharge is rather obscure. This little point of light also sometimes appears on the red hot platinum anode mentioned above, and we have seen it in other tubes, always at the place where Röntgen rays are apparently found.

Prof. Elihu Thomson has kindly sent us some sketches of tubes having the anode bombarded by the cathode, and we had previously designed some tubes of similar shape, but have not yet found anybody in this country capable of making a sufficiently good vacuum. In many of our best tubes the vacuum is so perfect as to cause a resistance equal to a five or six inch spark in the air. The better the vacuum the greater the number of rays sent out.

However, for sharpness of detail, nothing equals the perfect vacuum tube, having its electrodes one mm apart. Such a tube has been designed by one of us, but we have not been able to get the proper exhaustion.

As to other sources of Röntgen rays, we have tried a torrent of electric sparks in air, from a large battery, and have obtained none. Of course, coins laid on or near the plate under these circumstances, produce impressions, but these are, of course, induction phenomena.

As to sunlight, Tyndall, Abney, Graham, Bell and others, have shown that some of the rays penetrate vulcanite and other opaque bodies, and we have only to look at an unpainted door, on the other side of which the sun is shining, to convince ourselves that sunlight penetrates wood to a considerable depth.

As to the theory of the Röntgen rays we know little. If the rays are vibrations we can readily determine a rough limit to their length, from the sharpness of the shadows.

Thus our photographs have such sharpness that the complete waves cannot be more than .0005 cm long, but are probably much shorter. This is independent of whether the waves are longitudinal like sound or transverse like light, and of course only applies to that portion of them which affects the photographic plate. There may be others of larger size that do not affect the plate.

All efforts to bend the rays from their course, either within or without the tube, by means of a strong magnetic field, have failed, both in our hands and in those of others, and thus, if the rays are radiant particles of matter, they cannot be highly charged particles like the cathode rays. The rays are not refracted by any solid bodies so far tried, and this seems to be against their being waves either in air or ether. They pass through solid bodies, and thus their wave lengths can not be very small. We have before seen that it cannot be very great. They cannot be sound waves, as they proceed for some distance through a very perfect vacuum.

Altogether we are at a loss for a theory. If we have not yet got a satisfactory theory of light after more than a hundred years of labor, how can we hope to have a theory of the Röntgen rays after knowing of them for only a few months? Let us suspend our judgment for a while, and let us, above all things, be willing to alter our opinions at any moment when fresh light appears.

Diffusion and Opalescence with Röntgen Rays.

BY ELIHU THOMSON.

So far as the writer is aware, the phenomena presently to be described have not hitherto been alluded to by writers or experimenters on Röntgen rays. They are the phenomena of diffusion of such rays by certain classes of substances in such a way that such substances must come to be regarded as opalescent,* or to act like opal glass in ordinary light, or like milky liquids, a diffusion of incident rays taking place from the interior and exterior of the mass.

Some substances are found to behave with Röntgen rays in the way that compacted snow or translucent ice act in diffusing light.

Let a fairly large metal screen, such as a brass or iron plate, of one-sixteenth to one-eighth of an inch in thickness be suspended in a vertical plane about a foot or more from a Crookes tube kept in action and emitting rays toward the plate. On the side of the plate opposite to that nearest the Crookes tube there will, of course, be a space in shadow free from Röntgen rays. This statement, though true in the abstract, may not express the whole truth. It may easily happen that an exploration with a fluorescent screen tube, or fluoroscope, back of the metal plate will show that the rays are not absent there, but appear to come around the edge of the plate. This phenomena has been recently alluded to by Mr. Edison, and used in support of his suggestion that Röntgen rays are simply high-pitch sound-waves.

But upon close examination it will be found that the rays back of the metal shield are at least mostly due to diffusion from surrounding objects; the walls of the room, or the floor, or objects in the room receiving the rays and scattering them. Further examination will also disclose the fact that bodies differ greatly in their diffusive power, and that substances such as paraffin, wood, paper, pure rubber cloth of cotton or wool, the hand of a person, etc., which are comparatively transparent to the rays, are also fairly vigorous in diffusing them.

The diffusion is not merely from the surface or irregular reflection. This is shown by the fact that the surface may be smooth or rough, and that the rays come even from the back of the object and from portions not exposed directly to the original rays. This indicates a true opalescence like that possessed by opal glass with ordinary light. It will be seen from this that the shadows of opaque objects embedded in tissue at considerable depths can never be so black or dense as when the objects are merely surrounded by air.

Liquids appear to possess the property as well as solids. The diffusion appears to take place in all directions within and outside of the mass of the substance.

If the fluorescent screen tube used has metal sides of some

* Opalescence is here used to indicate the property of milkiness without play of color.

thickness, the large metal plate screen mentioned above can be dispensed with. In this case it suffices that the screen tube be turned so as to be directed at right angles to the direction of the rays or be turned away from the Crookes tube, so as not to fluoresce. Pieces of various substances may now be placed opposite the end of the screen tube, but in a position to be partially or wholly exposed to the rays. The pieces will become virtually sources of the rays, and the rays diffused by them reaching the fluorescent screen will cause it to emit light.

By placing two exactly similar fluorescent screens at opposite ends of a tube and employing a Bunsen photometer screen movable, as usual, between the screens, a comparison of diffusing power of different materials may be made by subjecting the pieces placed near the ends of the photometer tube outside, to equal radiation from the Crookes tube.

The same instrument might be employed to measure the relative merits of the Crookes tubes as producers of the rays. The same electrical discharges could be passed through both tubes while opposite each end of the "fluorometer" so also the comparative values of different fluorescent screen materials could be tested by slight modifications in the use of the instrument.

By comparing the density of the shadow of a piece of sheet lead, when back of a block of wood or paraffin and close to the fluorescent screen, with that of the same piece when the wood or paraffin is between the screen and the lead, the effects of diffusion in the latter case in lighting up the shadow are clearly seen on the fluorescent screen.

Though the experiment has not been tried as yet, the writer thinks that a cloud or mass of fine particles of water from a steam jet would diffuse the Röntgen rays. It is well known that the higher pitch light waves are most readily diffused and absorbed by fog, and if Röntgen rays be very high-pitch waves similar to light waves this diffusibility need not surprise us; the new rays to be in a sense detectors of molecular turbidity.

Whether these gases have the power of diffusing the rays is not known, but the diffusive power, if it exists at all, will be small and difficult to detect.

Metal plates gave apparently little diffusive effect, appearing to reflect feebly at angles equal to the incidence angles. The phenomena of reflection from surfaces have been investigated very recently by Mr. Tesla and a number of values obtained for the relative reflecting powers of metals, etc.

The diffusive action herein noted is different altogether from reflection, and is obtained at all angles from the surfaces, and from the interior of the materials upon which the original rays fall.

Electricity Direct from Carbon.

BY C. J. REED.

"Electricity direct from carbon" is an enticing theme. It has thus far proved both attractive and elusive to all its many enthusiastic investigators and investors. This sort of "electricity" is now discovered periodically, if we may judge from the regularity and frequency with which its discovery is heralded in the electrical and other papers.

The most recent paper of prominence in which this discovery is presented in new form is one by Dr. Alfred Coehn in the *Electrotechnische Zeitschrift* of March 19, 1896, p. 190, of which a very complete abstract appeared in THE ELECTRICAL WORLD *Digest* of April 11.

After describing his experiments, Dr. Coehn announces, as the result of his investigations, the following notable possibilities:

"First: It is possible by electrolysis to produce a solution of carbon.

"Second: From such solution carbon may be separated as a cation.

"Third: An element may be formed in which carbon is the soluble electrode."

Such a statement of possibilities seems to be perfectly safe. There are very few who would, even without investigating the subject at all, deny such possibilities, and the near future is not likely to bring forth any proof to the contrary.

There is no evidence, however, in the experiments described by Dr. Coehn that he has succeeded in accomplishing any one of those three "possibilities." But the evidence is conclusive that he has not.

First: He shows conclusively that his solution contains only compounds of carbon, such as carbon monoxide, carbo-hydrates and hydrocarbons. These are evidently not the kind of solutions he refers to when he speaks of dissolving the carbon in a fluid to form ions. These compounds are well-known "solutions" of carbon and are not electrolytes from which carbon may be separated by electrolysis.

A kind of solution Dr. Coehn was groping for and did not find was a *salt* of carbon, "in which the carbon is in the form of ions"; such as a sulphate of carbon, which would be an electrolyte, but which does not exist. Had he tried a haloid compound of carbon, such as CCl_4, he might possibly have come nearer to finding "carbon in the form of ions"—whatever that may mean.

Second: He shows conclusively (assuming his statements of the analyses to be correct) that the deposit he obtained, instead of being carbon, was a carbo-hydrate; that is, a compound of carbon with oxygen and hydrogen in the proportions in which they unite to form water. It may have been an oxidation product of his "soluble electrode."

Third: He does not even state that the deposit of this carbo-hydrate was obtained with an anode of carbon. He refers only to anodes of various kinds of coal and coke; all of which contain hydro-carbons capable of oxidation to carbo-hydrate. He did not show, therefore, that carbon was the "soluble electrode." That bituminous hydrocarbons are easily oxidized to carbo-hydrates by ozone, hydrogen peroxide or persulphuric acid (all of which may have been present in his solution) without any electrolytic action, ought to surprise Dr. Coehn.

Now, for the sake of argument, let us admit that Dr. Coehn has actually accomplished these three possibilities, though he has not published his researches in sufficient detail to admit of verification, and though his statements are entirely adverse to such conclusions. Let us admit (1) that he has produced electrolytically a solution of carbon in which the carbon is "in the form of ions"; (2) that from such a solution he has electrolytically deposited the carbon as a cation; (3) that he has formed a "soluble carbon electrode." What has all this to do with getting "electricity direct from carbon"? Is it not rather getting carbon direct from electricity? Is it not simply electroplating carbon? How can electrical energy be derived from carbon by such a process or any modification of it?

To oxidize carbon by electrical energy or by powerful oxidizing agents is one thing; to get electrical energy from carbon by its spontaneous oxidation is quite a different thing. It is possible to oxidize gold and platinum by electrolysis; but no one would think of trying to get electrical energy from the spontaneous oxidation of those metals. It cannot be done. They can only be oxidized at low temperatures by expending upon them the energy of the most powerful oxidizing agents.

What is true of gold and platinum in this respect is also true of carbon. At low temperatures it is one of the most highly electronegative elements known, having no affinity whatever for oxygen, chlorine, bromine, iodine or any other element.

It is only at high temperatures that carbon acquires chemical affinities. Then it becomes highly electro-positive.

Dr. Coehn also falls into the perennial delusion of supposing that a voltmeter is an indicator of "electricity direct from carbon," especially if one terminal is connected to a carbon electrode. This *ignis fatuus electrolyticus* does seem to be immortal.

There is one elementary fact that I believe it would be well for all discoverers of "electricity direct from carbon" to remember. It is that whenever two electrodes, whether similar or dissimilar, and of whatever nature, are placed, each in contact with a different electrolyte, and the two electrolytes are brought in contact with each other (and are capable of undergoing any spontaneous chemical reaction upon each other), an E. M. F. is always set up between those electrodes. Its value depends upon the materials employed, and its capacity depends upon the quantity of available chemical reaction.

Yet Dr. Coehn tells us, because he placed a lead plate surrounded by lead peroxide into dilute sulphuric acid containing a carbon plate and got 1.03 volts and .01 ampere while the lead peroxide lasted, that he has obtained electricity direct from carbon.

Legal Note.

Judge Robinson, in the Superior Court at Hartford, Conn., passed an order on the receiver of the Schuyler Electric Manufacturing Company, of Middletown, Conn., to distribute the funds on hand, amounting to about $75,000, to the preferred stockholders. The General Electric Company owns most of the preferred stock.

Notes on General Electric Alternating-Current Machinery—IV.

IT IS possible to operate lights on the three-phase system, either from a single transformer placed in one leg only, in case the number of lights to be carried is small compared with the total output of the generator, or from all three legs if the amount of lighting is to be large.

Figs. 38, 39, 40 and 41 show some of the different methods of connecting transformers in the three-phase system in order to obtain different voltages. With the same transformers the potential at the terminals of the secondary may be varied considerably, depending upon the connections of the primaries and secondaries. In Fig. 38, with the primaries and secondaries Δ connected, the ratio of transformation of primary and secondary is the same as the ratio of transformation of the transformers, so that, for instance, if the transformers have the ratio 10 : 1, and the primary potential between the lines is 1000 volts, the potential at the secondary between each of the three legs is 100 volts. If the primaries are Δ connected and the secondaries Y connected, as in Fig. 39, the potential between the three secondary lines will be 173 volts, or $100 \times \sqrt{3}$. If the primaries are Y connected and the secondaries Δ connected, (Fig. 41) the potential between each of the secondary mains will be $\frac{100}{\sqrt{3}}$ or 58 volts. The most economical system of distributing lights from the three-phase secondaries is by the use of the common connection; that is, by having the primaries connected Δ and the secondaries connected in the Y manner. And finally, if the primaries and secondaries are Y connected (as shown in Fig. 42), the voltages are transformed in the ratio of transformation of the transformers. Each transformer is then subjected to a lower voltage than that of the main, the ratio being $1 : \sqrt{3}$.

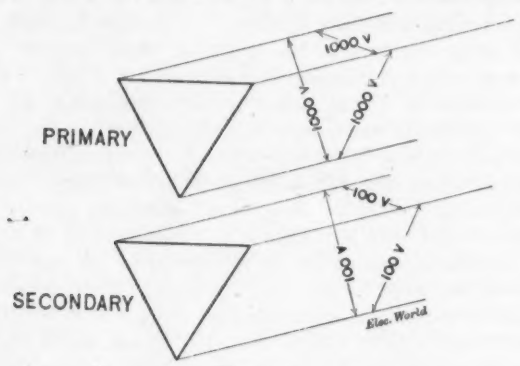


Fig. 38.

Monocyclic System.—This system is used where the power generated is mainly intended for lighting purposes, since in this system no unbalancing can occur.

This, however, does not imply that only a limited number of motors can be operated from a monocyclic generator, but the full current capacity of the latter can be utilized for motors; for instance, as day load. Where, however, only power distribution is intended the monocyclic system offers no advantages which cannot be supplied by the three-phase system.

The monocyclic system takes a trifle more copper than the straight single-phase system, as the monocyclic mains have to be calculated in the same manner as the single-phase mains and the teaser wire added, but since this system requires but two mains to those places where lights only are located, and the third teaser conductor to places only where motors are to be operated, the question of copper in the line of the monocyclic system can be treated in the same way as in the straight single-phase system.

The monocyclic system does, however, not necessarily include the monocyclic generator. Its main feature lies in the establishing of a displaced voltage which is used in starting and running motors.

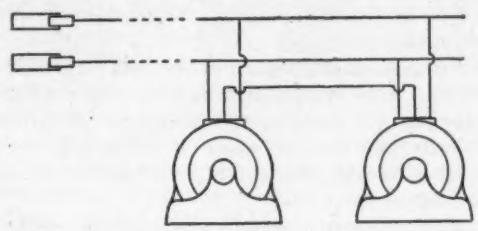


Fig. 40.

This displaced E. M. F. need not necessarily be derived from the generator, but can be supplied from any part of the system of distribution. Consequently if power is required at great distances from the generator, two mains only are run to those points, and by other means the displaced E. M. F. is established.

This may be accomplished, for instance, by a three-phase induction motor running single-phase. Although this motor is running single-phase, due to the interaction between its impressed and counter E. M. F., it will be found that at the terminals there exist E. M. Fs. of an approximate three-phase relation. One of these E. M. Fs. is that due to the main, the others being due to the resultants of the main and the out-of-phase E. M. F. established by the motor, as shown in Figs. 40 and 43, in the latter case transformers being interposed between the line and motors.

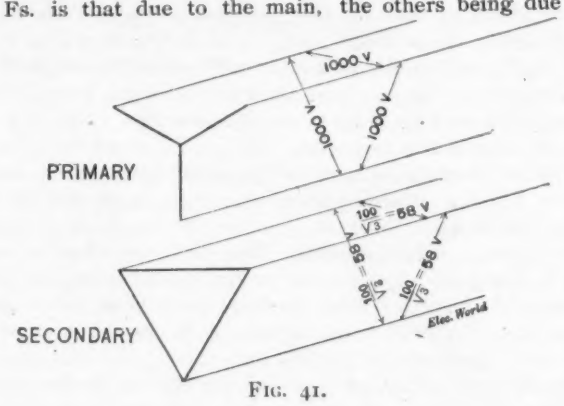


Fig. 41.

If leads are brought from this second terminal of the induction motor to other motors, as shown in Figs. 44 and 45, these motors will not only run up to full speed, but will start practically with any desired torque.

The action between the first motor and the others will be practically the same as if this third phase was supplied from a monocyclic generator or a special teaser winding. To go into a scientific explanation of this feature is outside the scope of this article, but we may briefly explain it by stating that since the field of the three-phase induction motor is supplied with a single-phase current, the three windings on the armature successively cut the magnetic field generated by the single-phase current, and consequently in the armature is induced a three-phase E. M. F. This counter E. M. F. of the armature consequently induces a three-phase E. M. F. in the

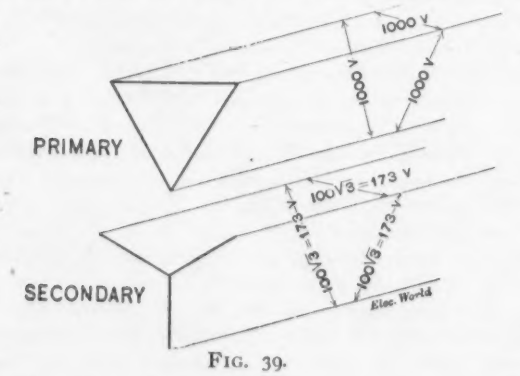


Fig. 39.

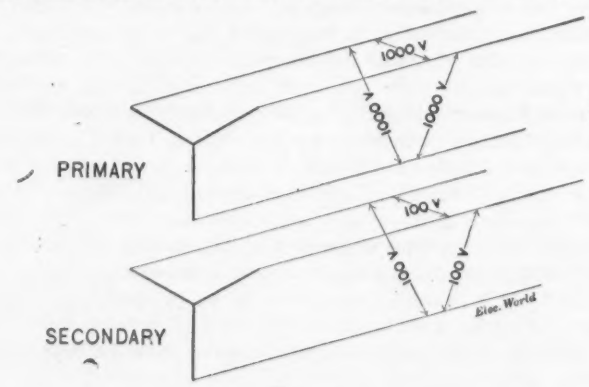


Fig. 42.

field. The interaction between this induced three-phase and impressed single-phase gives an E. M. F. of practically a three-phase relation at the field terminals.

The output of induction motors, when used on the monocyclic system is about the same as when used on the three-phase system. The current required at light load, the efficiency, the power factor and the apparent efficiencies are practically of the same magnitudes.

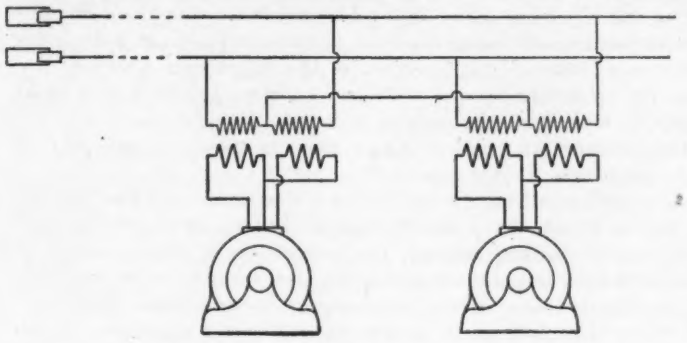
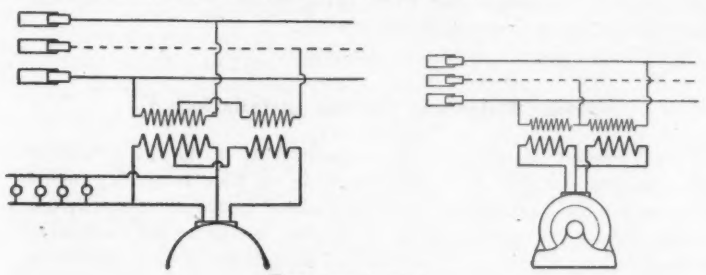


FIG. 43.

Fig. 43 shows how the transformers supplying power to induction motors operated on the monocyclic system are connected. It is seen that the primaries of the two transformers are connected in series and secondaries are connected in a reversed relation to each other. The teaser wire is brought over to the connection between the two transformer primaries and the two mains to the outside of the two transformers. In the secondary circuit the wire coming from the common connection of the two transformers is practically the return wire for the other two and consequently carries considerably more current than those, in fact about twice as much.



FIGS. 44 AND 45.

In the primaries leading to the induction motor the currents vary considerably, depending upon the load of the induction motor and the condition of the external circuit.

In the monocyclic system, as well as in any other system, either continuous current or alternating, it is not advisable to operate any but small motors from the same mains or transformers supplying lights, and it is therefore to be recommended that independent transformers be used for supplying the lights and motors respectively.

If the power is supplied through a secondary network, that is if the entire power is distributed from, say, one or two large transformers, motors might be operated from these secondary mains. To do this the connections shown in Fig. 44 should be used.

Postal Wires for the Opening Ceremonies.

In connection with the opening ceremonies of the National Electrical Exposition, when it is proposed to start the machinery by a circuit that has first looped in the whole continent, the Postal Telegraph Cable Company, through its vice-president, Mr. W. H. Baker, has very courteously offered its fine service between New York and San Francisco for the purpose. The Postal Company has been equipping its lines with heavy copper circuits, and believes that it can illustrate rapidity of working by the instantaneity of its transmission on the 4th of May, when the mere pressure of the golden key will flash the signal to the Golden Gate and back to the Exposition Building in the twinkling of an eye. Arrangements are now being made with the Postal officials for the execution of this interesting plan, with the co-operation of the long string of offices scattered over the 6000 miles of wire.

The Northwestern Electrical Association.

We have received a bound copy of the proceedings of the fourth annual convention of the Northwestern Electrical Association, which was held in Milwaukee, Wis., on Jan. 15, 16 and 17 last. It is complete and worth preserving.

The Chemical Theory of Lead Accumulators.

BY MAURICE BARNETT.

(*Continued from page 403.*)

In 1892 M. M. G. Darrieus, in a paper read before the Société Internationale des Elektriciens propounded the theory of the primary electrolytic reduction of PbO_2 to PbO followed by a secondary reaction between this PbO and H_2SO_4. The formation of sulphate from PbO follows the reduction of PbO to PbO_2, which is converted by sulphuric acid into metallic lead and sulphate of lead—the latter protecting the former from further oxidation. To account for the high E. M. F. of the cell he claims that the spongy lead produced electrolytically has greater chemical activity than soft lead ; and as it produces more heat in combining with acids than lead in its ordinary form one can understand how it can produce a higher E. M. F. than the latter.

We have now reviewed the various theories that have been advanced up to the present to explain the action of lead accumulators and the variations in E. M. F. which they exhibit. With the exceptions of the occluded gas theory we have commented on none of these—it being our object to make a brief statement of all the theories advanced and then to discuss in detail those possessing the greatest plausibility and importance.

To the layman it will seem strange that there should be any difficulty in explaining the chemical reactions taking place in accumulators, and in arriving at a theory of their action susceptible of easy demonstration. Admitting that the means were at hand for precise estimations of the chemical changes taking place in accumulators, it must be said that owing to the nature of the material examined the greatest difficulty is experienced in carrying on investigations in this branch of technological chemistry. These difficulties have long been perceived, and were pointed out by Dr. Frankland during the discussion following the reading of Prof. Ayrton's paper on "The Chemistry of Secondary Cells," before the Institution of Electrical Engineers (London), in 1890. These remarks were as follows : "The physical qualities of the cell are capable of very accurate estimation and investigation. But when you come to attempt to ascertain the chemical changes that occur in the charging and discharging of a storage cell you encounter formidable difficulties. Nothing seems more simple than to determine the chemical changes that take place in either the negative or the positive plate of a storage battery. It is not so in reality. The substances used as active materials are, in the first place, mixtures, and the materials obtained at the end of the reaction are also mixtures; and these mixtures are insoluble in any re-agent which does not decompose them. They cannot be volatilized, they cannot be subjected to any process of solution or crystallization in order to separate and purify their constituents."

From this it will be gathered that however painstaking the efforts, the difficulties encountered in the analysis of electrodes and electrolytes have made exact demonstrations of what goes on in secondary cells impossible. As a result of 15 years of study, the double sulphating theory has been elaborated to explain the activity of lead accumulators, but we are still at sea regarding the cause of the variations of E. M. F. in the cells—and of some of the phenomena of discharge.

As already pointed out, this theory comprehends the conversion of the active material of both electrodes into sulphate of lead. Before stating what seem to be like weak points in the theory, let us review the grounds for accepting it.

The theory gains its greatest support from the study of the thermo-chemistry of the cells. Although it is difficult to write a chemical equation that will express the electrolytic reaction taking place in accumulators, we can indicate by an empirical equation the net result of this reaction. Thus, starting with electrodes of Pb and PbO_2 and an electrolyte of the composition $(H_2SO_4 + xH_2O)$ where x is the number of molecules of water in combination with the H_2SO_4 participating in the reaction we have this equation,

$$Pb + PbO_2 + 2\left[H_2SO_4 \cdot x(H_2O)\right] = PbSO_4 + PbSO_4 + 2(H_2O) + 2x(H_2O), \qquad (6)$$

which represents the reaction between the molecules needed to effect the sulphatization of the Pb and PbO_2, but does not include the reaction between the bulk of the electrolytic and the water liberated, first, as a result of the hydration of the oxygen of the PbO_2 and, second, as a result of the dehydration of the dilute H_2SO_4 concerned in the reaction. If we call the bulk of the electrolyte E,

we can include this subordinate reaction by a re-statement of equation (6) as follows:

$$Pb + PbO_2 + 2\left[H_2SO_4 . \ x \ (H_2O)\right] + E = 2PbSO_4 + \left[E + 2x(H_2O) + 2(H_2O)\right] \quad (7)$$

Now it is clear that in withdrawing H_2SO_4 from the term $\left[H_2SO_4 . \ x \ (H_2O)\right]$ there will be an absorption of heat. It is also clear that the addition of $\begin{matrix}2 \ x \ (H_2O)\\ 2 \ x \ (H_2O)\end{matrix}$ to the remaining electrolyte will be attended by the production of heat. We can therefore write the heat equation as follows:

Heat of formation of $\left[2(PbSO_4) + 2(H_2O)\right]$ − Heat of dissociation $\left[2[H_2SO_4 . x(H_2O)] + PbO_2\right]$ + Heat of combination $\left[E + 2x(H_2O) + 2(H_2O)\right]$ = c. g. calories evolve (8)

Calling $x = 9$, which represents a degree of dilution corresponding to sp. gr. of 1.29, and assuming that the electrolyte is of such bulk that the dilution taking place during discharge produces a lowering of the sp. gr. by not more than .05, we can write the above equation with the thermo-chemical equivalents corresponding, thus:

$$\left[2(PbSO_4) + 2H_2O)\right] - \left[2[H_2SO_4 . x(H_2O)] + PbO_2\right]$$

(290260 + 136700) calories − (271250 + 62300) calories

$$+ \underbrace{\left[E + 2x(H_2O) + 2H_2O)\right]}_{1428 \text{ calories}} = 94838 \text{ c. g. calories evolved.} \quad (9)$$

which corresponds to an E. M. F. of 2.08 volts, which is the actual E. M. F. observed for the lead-lead peroxide couple in acid of 1.29 sp. gr. The double sulphate theory would thus seem to be borne out by thermo-chemical considerations.

This theory, furthermore, gains plausibility from the fact that in 1882 Gladstone and Tribe showed by chemical analyses that during discharge the active material of both electrodes was converted into sulphate. In 1883 Dr. Frankland's experiments led him to the same conclusion which has since been confirmed by Schenk and Farbaky, Ayrton and many others. Again, if this theory be true we should expect to see the electrolyte grow weaker in H_2SO_4 during discharge owing to the combination of (SO_4) with lead; and conversely we should expect to see it increase in H_2SO_4 in charging, owing to the reversal of the above reaction. As a matter of fact, these changes in sp. gr. of the electrolyte have long been known, for in 1883 Dr. Frankland showed that they could be utilized to indicate the state of charge and discharge of lead cells. Lastly, with regard to the negative electrode there is no reason to doubt that this action takes place because spongy lead reacts with sulphuric acid the same as iron or zinc or any metal that decomposes H_2SO_4 with liberation of hydrogen.

The fact at variance with this theory is the extreme difficulty of reducing lead sulphate to metallic lead. It has already been stated that Dr. Lodge contended against this theory on account of the seeming improbability of the activity of lead cells being dependent on the formation of so non-conducting and difficultly-reducible a compound as normal $PbSO_4$.

Mr. G. Darrieus, in the paper referred to, tried to meet this difficulty by assuming that in the conversion of PbO into $PbSO_4$ the sub-oxide Pb_2O is formed, and that the action of H_2SO_4 on this results in the formation of metallic lead and neutral sulphate. This view, however, does not assist matters, for it is just as easy to assume, in the case of the negative plate, that only half the metallic lead is converted into sulphate. E. J. Wade, writing for the London *Electrician* during 1894, advances a much more likely hypothesis in suggesting the possible formation of a sub-sulphate Pb_2SO_4 which corresponds to the sub-oxide Pb_2O_4, which is only with difficulty distinguishable from a mixture of PbO and metallic lead. In the same way Pb_2SO_4 would, under analysis, appear as a mixture of $PbSO_4$ and metallic lead; and he goes on to say, "It would, too, in all probability, have a considerable conductivity, and, therefore, be easily reduced on charging . . . sulphating would consist in the conversion of a molecule of Pb_2SO-Pb_4 into two molecules of $PbSO_4$.

$$Pb_2SO_4 = PbSO_4 = 2PbSO_4." \quad (10)$$

In support of his view Wade cites the experiments of Prof. Ayrton, the results of which were embodied in a paper read before the (British) Institution of Electrical Engineers toward the end of 1890. In these experiments one of the 7 *L* 1 cells of the E. P. S. 1888 type, was used; and, during the process of charging and discharging, portions of the active material were taken from both electrodes and studied qualitatively and quantitively—attention being bestowed, also, on their physical characteristics. It was found during discharge that the active material of the positives became hard while that of the negatives, soft. Wade does not think that these circumstances point to the production of normal sulphate at both electrodes, but rather in the direction of the hypothesis advanced by him. If it can be shown that any compound other than normal $PbSO_4$ is formed at the positive electrode, Wade's contention falls to the ground. As a matter of fact there is reason to believe that basic sulphate is formed there.

But quite apart from the hypothesis of Darrieus or Wade the formation of $PbSO_4$ as a direct reaction without extra assumptions seems a most unlikely action. Dr. Lodge's experiments, as well as those of Kelvin and of Gladstone and Tribe, were made on pure sulphate of lead. Now in the accumulator, under normal discharge, not more than half of the active material of the negatives is converted into sulphate; and since sulphation takes place uniformly throughout the active material the sulphate formed has distributed through it an equal amount of metallic lead from which it gains conductivity. That the electrolysis of pure $PbSO_4$ was not successful can be understood in view of the absolute non-conductivity of this compound. But as no difficulty has been experienced in reducing mixtures of $PbSO_4$ and PbO it seems highly probable that the conductivity preserved in accumulator plates affords an explanation how lead sulphate is reducible is lead cells while not in experiments where the electrolysis of pure $PbSO_4$ is attempted.

With regard to the positive electrode the sulphating is supposed to take place in two stages, the PbO_2 being reduced first to PbO and then this monoxide converted into $PbSO_4$.

(To be continued.)

Safety Rules for Electric Installations.*

The Verband Deutscher Electrotechniker, a German society corresponding to the American Institute of Electrical Engineers, has edited a code of safety rules for electric installations. In view of the discussion now prevalent on this subject, the following abstract, which comprises the principal deviations of this code from the Underwriters' National Electric Light Association code, may be interesting:

Rooms and Methods of Operation.—In storage-battery rooms no other than electric incandescent lighting is to be used. Such rooms are to be ventilated permanently and thoroughly. The different cells are to be insulated from the support and this latter from the ground by glass, porcelain or similar non-hygroscopic bases. Precautions must be taken to avoid all danger to the building, in case any acid should be spilled. During charging, glowing or burning, objects are not to be tolerated in these places.

Conductors.—Conductors of copper shall be of such a conductivity that a length of 55 metres (180 feet) of a wire of one square millimetre (about 1975 circ. mils) cross-section at 15° C. (59° F), shall not be of higher resistance than one ohm.

The highest allowable amount of current for wires and copper cables will be seen from the following table:

Current in Amperes.	Circular Mils.	Nearest B. & S. Wire.
3	1481	18
4	1975	17
6	2962	15
10	4937	13
15	7900	11
20	11850	10
30	19750	7
40	31600	5
60	49375	3
80	69125	2
100	98750	0
130	138250	00
160	187625	000
200	237000	0000
230	276250	5°
300	414750	7°
400	592500	9°
600	987500	12°

The smallest cross-section allowed for conductors except on and in fixtures, is one square millimetre (about 1475 circ. mils) on and in fixtures three quarters square millimetre.

* Abstract from the *Electrotechnische Zeitschrift*, Jan. 9, 1896.

If wires of other metals are to be used, the cross-sections must be taken in their correct proportion.

Bare conductors must be protected against injury or accidental touching. They are admitted only in fireproof rooms which do not contain combustible material; further, outside of buildings and in machine and storage-battery plants, which are only accessible to the persons in attendance. In exceptional cases also, not fireproof rooms, in which corrosive vapors appear, bare conductors are allowed, if the same are protected by a suitable covering to prevent oxidation.

Bare conductors are to be mounted only on bell-shaped insulators, and except those which form parallel branches not to be cut out, must be separated from each other for a span of more than 6 metres, at least 30 centimetres; for spans of 4 to 6 metres at least 20 centimetres, and for spans of shorter length at least 15 centimetres, and must be run from the wall at a distance of at least 10 centimetres. In storage-battery rooms and for the connections of the batteries to the switchboard, roller insulators and shorter distances are permitted.

Outside of buildings bare conductors are to be run at least four metres above the ground. Overhead conductors which are not protected by lightning arresters are to be provided with this apparatus in a sufficient number.

Bare conductors which are, when in working order, connected to the ground, are for the present not subject to above rules.

Single Insulated Conductors.—Conductors which are provided with a double tightly fitting covering of fibrous insulating material impregnated with suitable compound and free from breaks may be applied where corrosive vapors are not to be feared, upon bell-shaped insulators everywhere, upon insulating rings, rollers or equivalent fastenings, but only in absolutely dry places. They are to be placed at intervals of at least 2.5 centimetres.

Bare lead cables consisting of one copper core, of a heavy insulating layer and a single seamless single or double lead-mantle, shall never come into immediate contact with conductor fastenings, walls or lead-affecting substances. (Pure plaster does not affect lead.) Lead cables, the copper cores of which have less than six square centimetres cross-section, are allowed only when their insulation is made of vulcanized rubber or equivalent material.

Asphalt-covered lead cables can be used in dry places and dry ground, and are to be placed in such a manner that they cannot come in contact with the walls or substances affecting the lead.

Asphalted and armored lead cables may be placed directly into the ground and in damp places tube hooks may be used.

Lead cables shall be used only with terminals, branch boxes or equivalent outfit, which prevents effectively the penetration of moisture and at the same time furnishes good electric connection.

If rubber insulation is used the conductor has to be tin-covered.

Installation.—All conductors and apparatus have to be accessible throughout their whole extension, also after the installation, in such manner that they can be examined and changed at any time.

Conduits.—It is permitted to lay going and return wires in the same tubing; more than three conductors in the same tube is not allowed. If metal tubing is used for alternating currents, going and return wires must be placed in the same tubing. Wire connections are not to be made inside of the tube, but only in so-called joint-boxes, which can be opened easily at any time.

Wooden moldings are not allowed.

Metallic contacts shall be exclusively sliding contacts.

Every main branch shall receive if possible switches for all poles, the two outer conductors in the three-wire system in all cases, whether or not the different rooms contain special switches.

Lamps and Fixtures.—The current-carrying parts of the holders are to be mounted upon fireproof bases and to be protected by fireproof insulating covering. Hard rubber and other substances, which undergo by heat a change of form, and also artificial stone, are excluded as parts inside of the holders. Flexible cord pendulums are allowed only in those cases where the weight of the lamp with the screen is held by a special rope, which can be interlaced with the cord. On the suspension-point as well as on the holder the wires must be longer than the rope so that no strain will come upon the joint. In all other cases wires must not be used for suspensions, but suspensions must be used which afford easy control at all times.

Insulation Resistance of Installations.—The insulation resistance of the whole conductor network with respect to the ground shall amount to at least $\frac{1,000,000}{n}$ ohms.

For every main branch the insulation must be at least $10,000 + \frac{1,000,000}{n}$ ohms.

In these formulas, n means the number of incandescent lamps connected to the respective conductors, including an equivalent of 10 incandescent lamps for every arc lamp, every electromotor, or other current-consuming apparatus.

When new installations are measured the insulation is to be measured not only from the conductors to the ground, but also the insulation between two conductors of different potentials. For this purpose all incandescent lamps, arc lamps, motors, and all other current-consuming apparatus are to be disconnected from their conductors, while fixtures in use are to be connected, all fuses to be inserted, and all switches to be closed.

In measuring the insulation resistance the following rules are to be observed: To measure with respect to the ground with continuous current the negative pole of the source of current shall, if possible, be connected to the conductor to be measured, and the measurement shall be made only after the conductor has been exposed to the tension for one minute. All measurements of insulation are to be made with the working tension. In multiple conductor distributions under working tension the simple lamp tension is to be understood.

Besides these rules the code embodies an extensive set of rules and regulations concerning plans and drawings of electric installations and nomenclature concerning them. It also includes many minor and obvious regulations usually insisted upon by insurance inspectors, but not set forth in the code of the Underwriters' National Electric Light Association.

How to Use a Voltmeter as an Ammeter.

BY GEORGE T. HANCHETT.

It sometimes happens that in testing a dynamo or motor or in other work around a railway power station an accurate ammeter is very desirable. Sometimes switchboard instruments can be pressed into service, but often they are not sufficiently accurate, of limited range, or else they are too urgently required for their present service. In such a case some makeshift like the following may be very desirable, if not imperatively necessary for the work in hand.

If the terminals of a voltmeter are connected with the two ends of a resistance through which a steady current is flowing, a defection will be obtained which in numerical value is directly proportional to the current flowing in the resistance, and which only needs a multiplying factor to give the value of this current. This principle is utilized in the manufacture of almost every familiar type of direct-current ammeter and it is entirely feasible to apply it to other cases than in the manufacture of these instruments. For ordinary cases where small errors are admissible the multiplying factor is merely the reciprocal of the resistance. If we connect a voltmeter, as in Fig. 1, to the terminals of a resistance, the series-coil of a dynamo, for example, the current flowing is

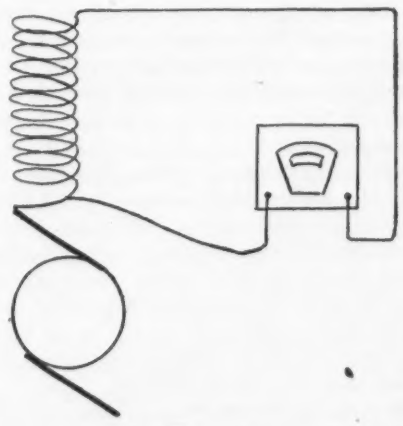


FIG. 1.

equal to the potential indicated by the voltmeter divided by the resistance of the series-coil, in accordance with Ohm's law. This assumes that the current taken by the voltmeter is a negligible amount, and with a good instrument its resistance is so great that even when its needle is fully deflected this may be

assumed to be the case. It will at once be seen that it is necessary to know the resistance of the coil in order that the calculation may be complete. If the measurements are not to be strictly accurate and the conditions will not be objectionably affected, a length of wire of known gauge may be inserted and used as the resistance. The numerical resistance of the wire is then only a matter of a few minutes' calculation with the aid of a wire table, which every electrician employed on such work should carry. It may be the case that an ammeter is at hand, but of too limited range to measure the output required. It will then be an easy matter to reduce the current to the limits of the instrument, and by taking a deflection at the terminals of the series-coil or other resistance it is proposed to measure with the aid of a voltmeter the value in ohms may be determined by dividing the voltmeter reading by that of the ammeter.

In any event the voltmeter may be connected around the resistance and its readings recorded and the resistance measured at leisure, or when accurate instruments are available. The initial readings of the voltmeter may then be readily translated.

It is important that the resistance, if it be an inserted one, be of sufficient carrying capacity to carry the current without overheating.

The scale of the voltmeter should be as low as possible. The reason for this lies in the fact that low resistances are most readily available as a usual thing, and the volt's drop through them is very small, and therefore can be measured accurately only by a low-reading voltmeter.

In railway power stations the portable voltmeter at hand is usually of 500 volts scale, but often has a 5-volt scale for use in calibrating. This 5-volt scale is eminently suited for such measurements as those just described. In case the voltmeter has no low-reading scale one may be provided at the expense of a little calculation, a little labor and a few cents' expenditure.

Most voltmeters consist of a sensitive mechanism in series with a large resistance as shown in Fig. 2. A few volts or often a fraction

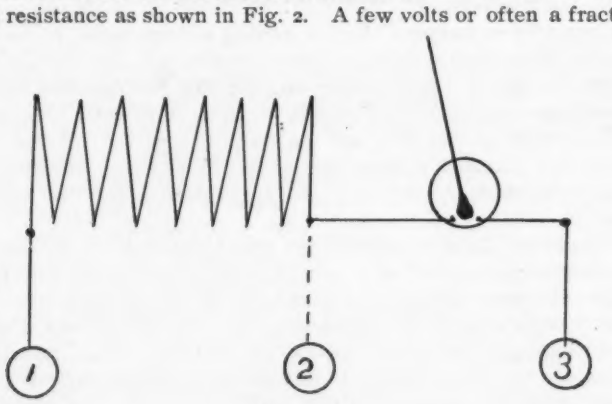


Fig. 2.

of a volt applied to the terminals of the mechanism alone would deflect it clear across the scale. The larger portion of the voltage applied to the terminals of a voltmeter is used in forcing the current through this enormous dead resistance in its construction. A mere fraction of the total voltage suffices to force the deflecting current through the mechanism. Therefore, to obtain a low-reading instrument, open the voltmeter and attach a light wire to the circuit, as shown, and bring it out to a neat binding post on the casing of the instrument, as shown by the dotted line. Some voltmeters have their resistances connected as in Fig. 3, and in that case two auxiliary wires will be necessary as shown. In the first case, 2 and 3 will be the terminals of the low-reading voltmeter. In the second case, binding-posts 3 and 4 would be used. It must be borne in mind that by attaching these terminals to any voltage greater than that which will deflect the needle fully across the scale the coil will be burned out. It is therefore necessary to proceed very carefully in determining what this voltage may be. It is as yet an unknown quantity and the pressure of an ordinary sal-ammoniac cell if applied to these terminals may ruin the instrument.

Having neatly made the connections as indicated, take the instrument to some good testing laboratory and accurately measure the resistance between the binding posts 2 and 3, or in the second case, 3 and 4. The total resistance of the voltmeter is usually given especially in the better makes of instruments, but if it is not, this must also be measured. It will pay to make these measurements with extreme accuracy, for after their completion you will have increased the utility of your voltmeter fully 50 per cent.

The multiplying factor to give true volts is now to be calculated as follows: Divide the resistance of the separated mechanism by the resistance of the voltmeter and obtain a multiplier, which, when multiplied into the voltmeter reading, gives the true volts at the terminals of its separated mechanism.

Taking a practical example, suppose the resistance of the voltmeter to be 5000 ohms and the resistance of the mechanism to be 45 ohms, the multiplier would then be $\frac{45}{5000} = .009$. Then if we connected the voltmeter by means of the circuit provided by the new binding posts and obtained a deflection reading 550, the true volts at the terminals would be $550 \times .009 = 4.75$ volts. It is obvious that the factor .01 would be much better for calculation purposes than .009. If it is desired to obtain this it can be done by unwinding a proper portion of the main resistance and connecting, as shown in Fig. 3, provided that the resistance of the mechanism is less than one one-hundredth of that of the entire instrument. This is a matter of some delicate manipulation and it should not be attempted unless the operator is skilled. The factor obtained by direct connection is just as accurate though less convenient. This change may be easily accomplished without breaking the seals which guard the mechanism.

The measurements which have been described thus far assume the voltmeter current to be negligible relatively to the current measured, and as the maximum current of a good voltmeter is not more than two tenths of an ampere, this is almost always the case in railway work. However, in the measurement of leakage currents, the calibration of instruments or in electrical investigation, this factor cannot be neglected, and therefore this case is considered.

Assuming as before that we have a known resistance through which an unknown current is flowing, it is evident that if we connect the voltmeter to the terminals thereof a portion of the current will be deflected through the voltmeter circuit, and the current through the main circuit which now divides through the voltmeter and the known resistance will be increased. If we consider that the known resistance and the voltmeter together constitute one instrument, we desire the value of the current feeding the two parts, and, therefore, the sum of the voltmeter and resistance currents. If R represents the value of the external resistance, and R the resistance of the low-reading voltmeter, then by the law of divided flow the combined resistance would be

$$\frac{R\,R_1}{R+R_1}$$

As the voltmeter indicates the true voltage across the terminals of the combination, the current would be

$$C = \frac{(R + R_1)\,V}{R\,R_1} \qquad (1)$$

where V is the voltage at the terminals. By choosing the value of the resistance R, Fig. 1, we can make the voltmeter deflection as great or as little as we please, and by properly proportioning it we can make the voltmeter read amperes directly without calculation or by the use of an easy factor of transformation. It is very desirable to have this resistance as low as possible and this to a certain extent limits our choice. As a good voltmeter should have a high resistance, so a good ammeter should have a low resistance and we must not depart from these conditions in shunting our voltmeter for

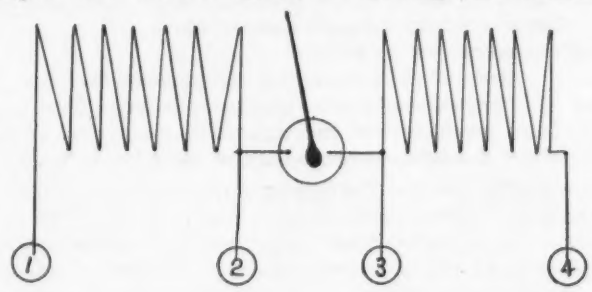


Fig. 3.

ammeter purposes. When we are using for a resistance some part of the actual circuit this condition does not limit us, but when we insert a resistance in series for this purpose it must be small in order first not to disturb the initial conditions, and second, not to absorb too much energy.

Consider the case of a 500-volt instrument with a calibrating scale of five volts. Suppose that we wish to have the instrument read amperes directly on its 500-volt scale, using the five-volt terminals in multiple with a resistance. What must this resistance be? Then

our assumption demands that for every volt which the instrument indicates on its five-volt scale 100 amperes shall pass through the system. We therefore have the condition that $100\ v = C$, and if the five-volt coil of the voltmeter has a resistance of, say, 45 ohms, equation (1) becomes

$$100\ v = \frac{V\ (R + 45)}{45\ R}$$

Whence $$R = \frac{45}{4499} = .010002$$

Had we neglected the resistance of the voltmeter we would have obtained R from simply $R = \frac{V}{C}$

$$R = \frac{E}{1002} = .01 \text{ ohm},$$

and the difference is in this case negligible. Hence, for ordinary work with a voltmeter of sufficient resistance to be a commercial instrument, no allowance for its resistance is necessary.

The resistance of .01 of an ohm is rather high for an ammeter, but were it used on circuits where dead resistance is inserted, *e. g.*, field circuits, this would not be an objection. Unfortunately, if we attempt to reduce the resistance of this instrument, the range is increased and the disproportionality of the two is still maintained. The only possible way to correct this would be to employ a voltmeter with a lower scale. Good voltmeters do not need a large voltage to deflect the mechanism across the scale. In most cases the merest fraction of a volt will suffice. Therefore, when the instrument is provided with a special binding post as previously indicated, a very good ammeter, suitable for any purpose in its range, can be constructed by this method of shunting. However, when the mechanism alone is brought out to binding posts, the resulting scale requires an odd multiplying factor to get true volts, and this factor must be multiplied into the equation of condition as well. Suppose for instance, in the case of this same voltmeter, that the factor is .0007, *i. e.*, the voltmeter reading must be multiplied by .0007 to get true volts. If we desire the scale to read directly the equation of condition would be

$$C = \frac{1}{.0007}\ v = 1428.5\ V$$

and making this substitution the procedure is the same as before.

It is sometimes necessary in laboratory practice to draw a very small current from a power circuit. This occasionally occurs in some railway testing, and to render this article more complete, the following method is given.

In such a case where the current is very small and the voltage relatively high, an ammeter of high resistance is not only unobjectionable, but is a decided advantage, provided the working portion of the circuit is of low resistance. Suppose the case of a voltmeter with a scale of 500 volts and a resistance of 10,000 ohms. If this be connected in series with any device across the 500-volt mains, the current flowing is equal to the voltage indication divided by the resistance of the instrument. Such an instrument as the one described can be read directly within five volts, and by estimating to within one half a volt. If, therefore, in this instance the reading was 475.5, the current would be .04755 ampere, measuring the current with far more accuracy than any but the best mil-ammeters. The great resistance which is often objectionable in such cases as these is no hindrance.

Exhibitors and Exhibits at the Electrical Exposition.

The following brief descriptions of some of the proposed exhibits of the many concerns that have secured space at the National Electrical Exposition, which will be held in New York City from May 4 to May 30, have been furnished to THE ELECTRICAL WORLD:

THE BRADFORD BELTING COMPANY, Cincinnati, will have an exhibit of belting, and "Monarch" insulating paint.

VACUUM OIL COMPANY, Rochester, N. Y., will exhibit high grade lubricating oils for electrical machinery of all character.

THE CROUSE-TREMAINE CARBON COMPANY, Fostoria, O., will exhibit a line of carbons, both solid and cored, and motor and generator brushes.

A. O. SCHOONMAKER, NEW YORK, will exhibit uncut mica and mica cut to sizes and pattern, and segments and washers of various forms as furnished to the trade.

THE NEW BRITAIN MACHINE COMPANY, New Britain, Conn., will have a No. 4 8-hp engine on exhibition, the engine to be directly connected to a Riker dynamo.

THE BALL & WOOD COMPANY, New York, will have an operating exhibit of a 150-hp Ball & Wood engine in connection with 100-kw Siemens-Halske multipolar dynamo.

THE MICA INSULATOR COMPANY, New York, will exhibit Micanite in its various forms. Eugene Munsell & Co. will also have an exhibit of mica. Mr. Jefferson will have charge of the exhibit.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, will exhibit dynamos, motors, motor generators and automatic controllers, as well as annunciators, burglar alarms, fire alarms, bells, etc.

R. B. COREY, New York, will exhibit "Bergmann" arc lamps, direct and alternating current, plain and ornamental samples; "Sun-Schmelzer-Nurnberg" carbons, and "Bergmann" knife switches.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., will make an elaborate display of the various kinds and styles of porcelain pieces for electrical purposes, also a display of Laclede and Hercules batteries.

THE AMERICAN CARBON COMPANY, Noblesville, Ind., will make an exhibit of arc light carbons, battery carbons and carbon telephone specialties, which will be in charge of its New York agent, the Peck Electrical Company.

THE FUEL ECONOMIZER COMPANY, Matteawan, N. Y., proposes to exhibit sample castings showing the latest improvements in this line, drawings, blue prints, photographs, etc., relating to various installations now in operation.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, manufacturers of transformers, St. Louis, Mo., will be represented at the convention by Messrs. H. A. Wagner, E. H. Abadie, of St. Louis, and John Mustard, of Philadelphia.

THE KEUFFEL & ESSER COMPANY, New York, will have a complete display of drawing instruments, surveying instruments, transits, levels, etc. A representative in charge will be glad to show courtesies to any friends who may call.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., will display four single-phase motors, one rotary transformer and one direct-current, direct-connected, 25-kw machine. Mr. Adams, the company's New York representative, will have charge of the exhibit.

THE AMERICAN STOKER COMPANY, Dayton, O., will exhibit the American Under-feed Stoker of the size adapted to any water-tube, tubular boiler, heating or puddling furnace. The exhibition will be in charge of H. W. Fullerton, the general manager of the company.

THE DIAMOND ELECTRIC COMPANY, Chicago, Ill., will have a full line of Scheeffer wattmeters for house service, operating on 2-cp, 4-cp, 6-cp and 16-cp lamps, thereby showing the accuracy and sensitiveness of the instruments. Also a full line of their Scheeffer transformers.

THE IRON CLAD RHEOSTAT COMPANY, Westfield, N. J., will exhibit samples of the different goods it manufactures, and if possible, will have some of them in operation. The company will be represented at the exposition by Mr. Charles D. Doubleday and Mr. Geo. L. Colgate.

CHAS. A. SCHIEREN & CO., New York, will exhibit large three-ply main-drive perforated electric belts for use on street railway generators, and smaller sizes of double-ply electric and perforated electric belts for use on electric dynamos for electric lighting, electric elevators, etc.

THE BIRDSALL ELECTRIC MANUFACTURING COMPANY, New York, will show a full line of its various electric novelties, including cigar lighters, smokers' sets, electrical illuminated clocks, musical jardinieres, electrical flowers, electrically lighted lamps, etc. Also surgical and dental apparatus.

THE PHŒNIX IRON WORKS COMPANY, New York, will exhibit one Dick & Church tandem-compound non-condensing automatic cut-off engine of 125-rated horse-power. This engine will be direct-connected to a 75-kw generator, made by the Walker Manufacturing Company of Cleveland, O.

HUEBEL & MANGER, Brooklyn, N. Y., intend making a nice display of all their goods. Their representative, Mr. W. W. McChesney, Jr., will be in charge, and Mr. Huebel and Mr. Manger expect to be at the convention most of the time, and will be pleased to extend a welcome to all of their friends.

THE TUCKER ELECTRICAL CONSTRUCTION COMPANY, New York, will exhibit the auto-telephone system, a special new feature being the hotel telephone system, which can be installed on any existing

bell wires. The company also show the desk light for pigeon-holes on a roll-top desk.

The Kennedy Valve Manufacturing Company, New York, will exhibit a line of its extra heavy valves, both gate and globe, specially designed to meet the requirements of modern electric light and power plants. In addition to the above it intends to exhibit a line of standard valves.

The Columbia Rubber Works Company, New York, will have an exhibit confined strictly to hard-rubber specialties used in electrical work, such as hard-rubber sheet, rod and tubing, telephone receivers, push buttons and all goods of that class, together with a fire-proof compound which it is introducing.

The American Electric Heating Corporation, Boston, will show a complete line of cooking utensils, which will be in practical use during the entire period. In addition to this there will be a full assortment of laundry irons, tailors' gooses, glue pots, pitch kettles, office radiators and heaters and car heaters.

The Watertown Steam Engine Company, Watertown, N. Y., will exhibit a 10 x 12 Watertown high-speed single-cylinder engine, direct-connected to an Eddy dynamo. It will be in charge practically of Mr. Robert E. Cahill, but associated with him will be Mr. L. Copleston, manager of the New York office.

Henry R. Worthington, Brooklyn, N. Y., proposes to make a special feature of electrically driven pumping machinery, and will have on exhibition, operating, two sizes of electric house tank pumps ; also a small 2¼ x 4 horizontal electric pump, and a triplex steeple pump of larger capacity, directly geared to a motor. The exhibit will also include a Worthington test meter with special fittings, and a number of small pumps of our latest designs for various services.

The Harrisburg Foundry & Machine Works, Harrisburg, Pa., will exhibit a Harrisburg self-oiling automatic engine, direct-connected to a 40-kw Eddy generator. This will be a combination exhibit, and will be directly represented commercially by W. R. Fleming & Co., Mr. Coho representing the Eddy Company. It will be a working exhibit.

The New York & Ohio Company, Warren, O., will exhibit a full line of samples of incandescent lamps, ranging from 5 to 500 candle-power. The Packard Electric Company will also exhibit its transformers in the same space. Messrs. Stanley and Patterson, New York City, will have charge of the exhibit, and Mr. W. D. Packard will also be present.

De Veau & Co., New York, will have an exhibit of telephone switchboards, long-distance telephones for exchange use, telephones for factories, offices, etc., and transmitters, receivers, and all parts and necessary supplies for exchange use and general telephone work. Mr. De Veau or A. F. Stanley will be in attendance during the exposition.

The Stanley Electric Manufacturing Company, New York, will exhibit a two-phase S. K. C. generator arranged to show the working parts as well as the parts in process of manufacture ; also a two-phase alternating-current motor, as well as transformers shown in detail. The company will also have a full line of switchboard apparatus of most recent design.

The Straight-Line Engine Company, Syracuse, N. Y., will furnish one 15 x 13 125-hp Straight-Line engine of new design, direct connected to a General Electric Company 75-kw dynamo to furnish electricity for the Exposition Company. It will also furnish a 11 x 14 80-hp engine, direct connected to a Crocker-Wheeler 50-kw dynamo. This engine is to be driven by compressed air, and will stand on the main floor.

John A. Roebling's Sons Company, Trenton, N. J., will have some sample boards showing the various kinds of insulated wires manufactured by the company. The booth will be in charge of Wm. L. Doyle and Mr. M. R. Cockey, of the New York office, and Mr. Robert Welch, of the Trenton office. The booth will be furnished as an office, rather than as a show room for the exhibition of their goods.

The C. W. Hunt Company, New York, will exhibit a conveyor adapted to handling the coal and ashes for the boiler which will furnish the power for the work. Coal will be received and carried to the boilers, and the ashes will be taken away therefrom by the conveyor, the operation being noiseless and free from dust, with the use of the minimum amount of power. Mr. Harry P. Barr will be in charge of the exhibit.

The Anchor Electric Company, Boston, will exhibit a full line of specialties, including switches, sockets, cut-outs, watch-clocks and gongs. The company will also have a new advertising specialty that it thinks will attract considerable attention. Mr. H. C. Hawks, Mr. N. Marshall and Mr. P. M. Reynolds will probably spend two or three days at the convention, and Mr. Field, the company's New York representative, will be there most of the time.

The Nowotny Electic Company, Cincinnati, O., will display its well-known ironclad dynamos and motors. It also expects to have a dynamo in operation with an armature so constructed that it is absolutely impossible for it to burn out. The armature proper will be made of laminated iron, bare copper and insulated throughout with mica, there being no combustible material of any character whatsoever in it. The company will also exhibit its new rheostat and its new arc lamp.

Wm. F. Bossert, Utica, N. Y., proposes to have a sample board which will contain a complete line of junction and branch boxes for iron and brass armored conduit work, also distributing boards encased in fireproof iron boxes. These boxes, if used for iron armored conduit, are threaded to receive conduit, and all are furnished complete with fuse-connections and wire terminals for any size or number of conduits and branches and for either two, three or five-wire system.

The Standard Paint Company, New York, has taken 250 feet of space, and will display its P. & B. insulating compound, armature varnish, tape, insulating papers, as well as ruberoid roofing, which is specially adapted for power-houses, etc. The company will also have an attractive display of the "ship" cored and solid carbons, for which it is the sole United States agent. The company will be represented at the exhibit by Messrs. J. N. Richards, F. F. Van de Water, H. W. Benedict and J. Langan.

The Eddy Electric Manufacturing Company, of Windsor, Conn., will have an exhibit under the management of H. B. Coho & Co, of New York. It will consist of one 40-kw Eddy generator directly connected to an Ideal engine, also a marble switchboard, which will be exhibited and erected by Mr. Augustus Noll, the switchboard to contain many new features. There will also be exhibited some small Eddy motors, and some brushes, lamps, etc.; a 30-kw generator with a Watertown engine will also be shown.

Hugo Reisinger, New York, will have a fine display of "Electra" high grade Nuernberg carbons for arc lighting, for direct-current arc lamps on incandescent circuit and for alternating-current arc lamps ; every description of the finest grade of microphone carbons; finest grade of battery carbons; carbons for search lighting, for the manufacture of aluminum and for smelting all kinds of ores. Mr. J. F. Outwater, formerly of the Edison Electric Illuminating Company, of Brooklyn, will, with Mr. Fred Nolker, represent Mr. Reisinger at the exposition.

The Payne Engine Company, New York City and Elmira, N. Y., will have one of its new type direct-connected engines of 50-hp capacity connected to a 25-kw Card generator. This machine will have an improved inertia governor; also an automatic return oil circulation system, by means of which the oil is delivered in a stream to the main bearings by gravity and drained to a central point at the bottom of the base. The Payne Company will be represented at the exposition by Messrs. S. H. Payne, N. B. Payne and F. N. Jewett, of the New York office.

Stanley & Patterson, New York, propose to exhibit general electric light and electric bell supplies. As Eastern agents they will represent the New York & Ohio Company, manufacturers of Packard lamps; Brunt & Thompson, manufacturers of porcelain goods; Indiana Rubber & Insulated Wire Company, manufacturers of Paranite wire, and the E. G. Bernard Company, manufacturers of dynamos and motors. Either Mr. Patterson or Mr. Stanley will probably be in attendance most of the time at the exposition, assisted by one of their salesmen.

The Card Electric Motor & Dynamo Company, Cincinnati, O., will display, in part, the following apparatus: One 25-kw generator directly connected to a Payne high-speed, automatic engine. A motor operating a Hoe press, the armature of the motor being directly connected to the shaft of the press in the place of the pulleys. A motor directly connected to a 37-inch Niles boring mill. A motor directly connected to a Niles 6-foot radial drill and a 3-hp motor belted to a horizontal boring mill. They will also supplement their exhibit with some other special features which have not as yet been definitely decided upon.

Partrick & Carter Company, Philadelphia, will exhibit a general line of house goods consisting of hotel and house annunciators, burglar alarms, hotel fire alarm systems and return calls, and also a full assortment of bells, pushes, and numerous other household electrical appliances. The company will have in operation a complete line of goods manufactured by it, and will have present during the exhibition two or three of its most competent salesmen, including Mr. Thos. L. Townsend, to meet its many friends who visit the exhibition. It is also the intention of the firm to be at the exposition as much as they can conveniently do so.

The Walker Company, Cleveland, O., will have an exhibit in two parts. The part on the main floor will include one 30-hp railway motor complete—open for inspection; one armature partly wound; one railway controller—for double 30-hp equipment; one railway controller—for double 125-hp equipment; one 50-hp railway motor, open; one 50-hp armature; one standard railway generator panel; one standard railway feeder panel; photographs and literature. In the basement the company will have an 80-kw dynamo for incandescent lighting, which will be direct coupled to a Phœnix Iron Works engine and will be used to supply a portion of the light and power for the exposition.

The Standard Underground Cable Company, Pittsburg, will exhibit several reels of standard fibre insulated cables, standard paper insulated cables, and standard rubber insulated cables, and a specialty will be made of samples representing some of their most important recent contracts; they will have a show rack for wires and cables and small samples especially of lead-covered cables for distribution, and will distribute a novel electrical souvenir. Manager G. L. Wiley, of New York, and an assistant will attend the exhibition regularly, and Vice-President Marsh, of Pittsburg, and Manager J. R. Wiley, of Chicago, will be present part of the time.

Patent Office Exhibit.—In view of the importance of the occasion, the exhibit of the United States Patent Office at the National Electrical Exposition will be made one of unusual size and interest. As now arranged by the Department, under the instructions of Mr. S. T. Fisher, the acting commissioner, it will include no fewer than 361 separate models of electrical devices, apparatus, machinery and appliances, many of them embodying the fundamental and elementary ideas upon which the modern electrical arts have been founded. These models will occupy over 300 linear feet, and will be carefully grouped and classified, so that students, of whatever character, can follow the general lines of growth or evolution.

Manning, Maxwell & Moore, New York, will exhibit with the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company and the Hayden & Derby Manufacturing Company. The Ashcroft Manufacturing Company will exhibit its celebrated Tabor indicators, the steam and vacuum gauges, revolution counters, etc., of its own make; also the Edson recording gauge and the Moscop recorder. It is the intention to have one of the Edson gauges connected up in the exhibit, which will show a careful record of the steam pressure carried on the boilers furnishing power for this exhibit. The Hayden & Derby Manufacturing Company will exhibit its Metropolitan injector, and the Consolidated Safety Valve Company its nickel-seated safety valves.

The Adams-Bagnall Electric Company, Cleveland, O., will have on exhibit and in running condition 1 black japan series lamp, shunt; 1 seventeenth century brass series lamp, differential; 1 oxidized copper 100 hour lamp; 1 aluminum 100 hour lamp; 1 yellow brass alternating lamp, 1600 alternations; 1 Japanese copper alternating lamp, 7200 alternations; 1 oxidized silver constant potential lamp; 1 oxididized brass constant potential lamp; 1 marine lamp, black Japan; 1 100-hour old gold lantern, also 1 nickel railway lamp to run 9 or 10 in series on the railway circuit, all of the improved "A-B" pattern. The "A-B" incandescent lamp will also be shown. Testing instruments will be in circuit, and any of the above mentioned lamps will be subject to test at any time during the exposition.

The General Electric Company will occupy about 400 feet of space, which will be fitted up as a headquarters and general reception room. As a still exhibit the company will show a few of its latest long-burning arc lamps, a selection of its inclined coil instruments and a few meters. The convention committee of the company will probably be present during the exposition period. This committee consists of S. D. Greene, chairman; Chas. T. Hughes, vice-chairman; Fred. M. Kimball, secretary; A. D. Page, lamp works; T. Beran, of the New York supply department, and F. N. Boyer, of the Chicago supply department. In addition to these gentlemen the company's representatives from Philadelphia, Chicago, Atlanta and Boston, and some from the railway, power and mining departments, and the New York office will be in attendance.

The Interior Conduit & Insulation Company, New York, will show in operation a printing press run by direct-connected Lundell motor; exhaust fan outfits; 60 inches, 36 inches and 12 inches; direct-connected generating set; Lundell power motors, Lundell generators, Lundell desk fan motors and ceiling fan motors, Lundell dental outfits, Lundell emery wheel grinder, Lundell buffing machine and Lundell organ blowing outfit. The latter outfit will be attached to a Mason & Hamlin organ, which will be played each evening. The company will exhibits its complete system of plain, brass armored and iron armored insulating conduits, as well as its complete underground conduit system. It will show an illuminated sign 30 feet in length. The following named gentlemen will be in attendance: D. C. Durland, Geo. H. Kimber and E. B. Kittle.

The Electric Storage Battery Company, Philadelphia, Pa., will show a storage battery of 128 cells in operation, capable of supplying 400 16-cp lamps, (suitable either for central stations or isolated plants) used in conjunction with the Edison system, charged during hours of light load, when current is supplied at a special rate; a motor driven booster for charging battery in connection with the Edison system, built by the Electro-Dynamic Company, Philadelphia, Pa.; a white marble switchboard in oak cabinet, showing the latest type of controlling apparatus for storage battery work; an electric carriage propelled by storage batteries (designed by Morris & Salom), similar to the carriage which won the gold medal in Chicago road race; an electric launch, 21 foot, propelled by storage batteries, handsomely finished with mahogany and natural wood. The exhibit will be in charge of Mr. Chas. Blizard, assisted by Messrs. R. W. Rundle, W. O. Knudson and T. B. Entz.

J. C. Vetter & Company, New York City.—The object of their exhibit at the National Electrical Exposition will be to demonstrate the application of the constant incandescent current in electrotherapeutics, by means of various instruments designed for the purpose. This apparatus consists of the following: Vetter current tap, by means of which the current from any lamp socket can be carried to a drop light or fan motor without interfering with the lamp. Vetter current adapter, by means of which the lamp in the socket can be placed in series, and the current thus reduced and limited by the capacity of the lamp. Vetter carbon current controller, volt controller, standard mil-ammeter, cautery rheostat, also various combinations of the above in the way of table bases, switchboards and cabinets. A feature of the exhibit will be a cabinet lately designed for Dr. F. Heuel, of 26 Irving Place, which, in connection with the constant incandescent current, furnishes for electro-therapeutical purposes the various currents required.

Early Dynamos at the Exposition.—Cornell University is among the many contributors of interesting objects at the electrical exposition. It is in possession of the Gramme dynamo, built by Prof. W. A. Anthony as early as 1876, and exhibited as a great curiosity at the Centennial Exposition of that year. It was probably the first dynamo of practical form constructed on those lines in this country. It was used for arc lighting and for a great variety of purposes in those early days. It has remained in use ever since, and Dr. E. L. Nichols writes that even now they are using it at the University. The art has seen many remarkable evolutions, making this machine as great a curiosity in 1896 as in 1876, and it will doubtless be a centre of attraction to all students of dynamo construction. Cornell is also exhibiting other things of interest, and its work for the success of the exposition is but natural in an institution that benefited so nobly by the first fruits of electrical invention and industry. Other very early dynamos are to be shown.

The Evolution of the Stock Ticker.—An exhibit that is sure to arrest the attention of the numerous visitors to the exposition will be that which shows a stock-ticker system in full working operation. To watch the tape unroll with the curt little signs on it is one thing, but to see how the information that means so much to the financial world is gathered and put on the circuits is another matter of interest to everybody. The development of the modern stock-ticker system, so strikingly American, is the result of much ingenuity and enterprise, and has brought many brilliant electricians to the front. With the object of assisting to a better understanding of the subject, the executive of the Gold & Stock Telegraph Company has generously authorized its superintendent and electrician, Mr. George B. Scott,

to place at the disposal of the exposition management a number of old instruments that will be useful in showing how the system, as it exists to-day, has been worked out to its present stage of efficiency and celerity. Mr. Edison and others are also contributing apparatus of this nature, rendering the display one of unusual value, as such electrical machinery has never been brought together before in this instructive manner.

Mr. T. A. Edison will show in telegraphy stock printers, the phonoplex, the quadruplex, American District system, train telegraphy and his rote recorder, the first invention he ever made. In telephony he will show several varieties of apparatus, including microphones, the chalk transmitter, motograph receiver, etc. He will also show his interesting megaphone, odophone, etc. In lighting, Mr. Edison will show his earliest incandescent lamps, first converter, models of systems of distribution, multiple carbon lamps, centre pole lamps, first chemical meter, lamp Leyden jar, platinum lamp, etc.; also the first fixtures used. In the line of power transmission, Mr. Edison will exhibit some very early motors and models of great interest. Among miscellaneous exhibits may be named his pyromagnetic motor, etheroscope, tasimeter; the various stages in the evolution of the bamboo filament; magnetic friction devices; his early and latest phonographs, also his recent fluoroscopes. He has also in course of construction four sets of apparatus with which experts from his own staff will give exhibitions of the Röntgen rays, so arranged that by using the fluoroscope put into the hands, people can inspect their own anatomy. The Crookes tubes will be mounted in connection with mercury pumps, so that in a rough way the process of lamp exhaustion will also be demonstrated.

Storing Niagara Energy for the Exposition.—The announcement was made last week of the generous offer of the Western Union Telegraph Company of two wires from Niagara Falls, with which to bring current from the power plant there to run the model of the plant at the exposition. These wires will be available in the evening, and the question thus arose as to what should be done in the way of running the model the rest of the time during each day. Mr. A. S. Brown, the electrical engineer of the Western Union Telegraph Company, suggested that it would be a comparatively easy thing to ship a few storage batteries up to Niagara, charge them there and bring them down for the purpose. This suggestion has been acted upon, and the Electric Storage Battery Company, of Philadelphia, through Mr. Chas. Blizard, its representative in this city, has placed at the disposal of the Exposition all the batteries that may be needed, with the permission that this stored Niagara energy can also be turned loose on any other exhibit at will. There will thus be exhibited the energy of Niagara in a "live" form, coming over the wires in the shape of an alternating current to drive the model by an alternating current motor; and the stored Niagara energy, which will be applied to a direct current motor, which will also run the model part of the time. A more interesting illustration of the flexibility of electrical power transmission than this could hardly be desired as it practically embraces the whole field of modern methods and appliances.

The Metropolitan Telephone Company's Exhibit.—Realizing the impracticability of adequately exhibiting the working of its complicated and extensive plant in any reasonable space, the Metropolitan Telephone & Telegraph Company will make an exhibit illustrative of its New York City service as viewed from the user's standpoint. The manner in which this will be carried out involves nevertheless a more elaborate installation than might appear from the exhibit proper as the company will place telephone stations at a number of exhibitors' spaces as well as at points where service is desired by the exhibition company. These stations will be connected to a switchboard in the company's space, thus forming a small exchange within the exhibition itself. This service will be furnished without charge to the exhibitors and to the exhibition company by the Metropolitan Telephone Company, which will furnish the entire installation and maintain the service at its own expense. Besides the switchboard the company will install in its own space four silence booths of different types, each equipped with telephone instruments of the various styles used by New York City subscribers. These will all be working stations connected with the Thirty-eighth Street Exchange and will be available to visitors to the exhibition in the same way as an ordinary public pay station. The exhibit proper will afford the public ample illustration of the methods of operation employed by the Metropolitan Company and of the high grade of equipment provided for public and subscribers' stations.

High-Voltage Lamps.

To the Editor of The Electrical World:

Sir:—I must join issue with you on your editorial in The Electrical World of April 18 concerning high-voltage lamps, in which you state that the fact of a more extended use of eight-cp lamps in England than America has no doubt materially aided the English manufacturers in the production of a successful 220-volt, 16-cp lamp. The reverse is the case. For all that has been successfully done in England at the present time is to join two eight-cp, 110-volt filaments in series, which passes as a 220-volt lamp. The truth of the matter is that their 220-volt lamps are, therefore, a failure from the very fact of their using two eight-cp filaments in series. The difference in potential between the two coils being much greater than if but a single filament were used, the tendency to arcing is greatly increased.

Some time since, having read in the English technical journals a good deal of the success and efficiency of the high-voltage lamps in England, we sent there a sample of our 220-volt lamp to a prominent electrical engineer, requesting that he send us some samples of the best types of English lamps. We quote the following from his reply: "I refrain from sending you 220-volt lamps as they are double filament in series and range in actual voltage from 215 to 225, and as such no good for your purpose."

The inference might be drawn from your editorial that America is being outstripped in the manufacture of high-voltage lamps. Facts controvert such an assumption. Speaking for my own company, who were the pioneers in producing in this country high-voltage lamps of practical efficiency, I would say that a great many stations have been installed using the 220-volt lamp. The two-wire, 220-volt system was adopted as being considered preferable to the three-wire system in these particular cases. Several stations, however, employing the three-wire system have likewise been using the high-voltage lamp.

So long as incandescent lamps are constructed as at present, lower voltage lamps will have the advantage in efficiency, but the 220-volt lamp (which is successfully built for as high a pressure as 250 volts) will have a distinct field of its own for smaller central stations in which coal is not an important factor, and in which the business will be scattered over an area of three or four square miles. The two types will hardly conflict, as a well-informed engineer, when the facts of the best possible efficiency in either kind together with the local conditions are laid before him, can readily determine which is the better suited to the condition presented.

New York. Converse D. Marsh.

An Arc Phenomenon.

To the Editor of The Electrical World:

Sir:—A correction in the *Digest* of April 4 entitled "An Arc Phenomenon" needs a commentary lest it lead to misunderstanding. The critical point was discovered by me and showed itself in two ways; a sudden fall in the current and a sudden rise in the difference of potential at the electrodes.

Prof. Pupin, while assisting me one evening, corroborated my observation, and upon further investigation noticed that the arc changed to a veritable gas discharge, the *negative* electrode becoming heated, and not the positive, as is the case in an arc.

School of Mines, Columbia University. W. H. Freedman.

[If we correctly understand Mr. Freedman, he was the first to recognize that the character of the arc becomes entirely changed when the voltage attains a certain value; but the fact, that at the same time the negative electrode became the hotter, was first called to his attention by Dr. Pupin.—Ed.]

Wave-Length of Röntgen Rays.

To the Editor of The Electrical World:

Sir:—A more exact measurement of our sharpest negatives shows us that the portion of the Röntgen rays which affect the photographic plate cannot have a wave-length greater than 0.000,007 cm, or one-seventh that of yellow light. The measurement is rough, and I only give the figure as a provisional one. Should it be confirmed, I believe it would go a long way toward disposing of the wave theory of these rays, as short waves are much more quickly stopped by matter than long ones, according to all we know at present. H. A. Rowland.

Johns Hopkins University.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Regulating Motors. BURKE system. *Elec. Eng.*, April 15.—A brief, illustrated description of a method for obtaining a variation in speed. There are two machines, each giving one half the desired delivery; their shafts are mechanically connected; their armatures are in series and the fields are shunt-wound; for the slowest speed they act in unison as motors, the speed being increased by reducing the field of one of them, thereby transferring the voltage of the line to the other, and then by reversing the field on the former and gradually increasing it, thereby adding to the line voltage the voltage of the former machine, the latter receiving the combined voltage.

LIGHTS AND LIGHTING.

Public Lighting by Arc Lamps. BLONDEL. Lond. *Elec.*, April 13.—The beginning of a translation of a paper from *La Revue Technique*. It deals with the practical side of the question of street lighting; it is accompanied by a number of illustrations of various devices, and contains much practical data, only the most important of which can be given here. He calls attention to the importance of good diffusion when arc lights are used, while it is only of secondary importance with incandescent lamps or gas; he deals more practically with the continuous-current arcs, with some reference to alternating ones; he intends to make a detailed examination of the means at present used in the production and utilization of this source of light, indicating some possible improvements. In considering the arc light as a transformer of energy into light, he shows that its economic value may vary between wide limits; regarding the grouping of lamps, he shows the importance of putting as many as possible in series on constant-potential mains, thus reducing the resistance, which is necessary to steady the light; regarding the series system used in this country, he states that while from this point of view it is the most economical, the lower efficiency of the special machines required balances the gain, and he believes it far better therefore to connect the street lamps with existing circuits. He shows the importance of a proper choice of the carbons, stating that the advantage of small diameters is no longer doubtful; Schreihage found experimentally that the mean spherical power is almost inversely proportional to the diameter of the carbon; he describes his lumenmeter for measuring the total luminous flux and gives a table of results which show that the efficiency of a pair of 14 and 8 mm carbons is three times that of a pair of 21 and 13 mm; he advocates reducing the size of the carbons, claiming that they should be reduced to 10 and 7 or 8 mm for 10-ampere lamps. Siemens showed that 10-ampere lamps may be worked with 10 mm positive and 3 mm negative carbons, which, however, he considers too small; in general, the maximum diameter of the carbon in millimetres should not exceed the number of amperes; this may be accomplished by increasing the travel of the carbon holders, or by using double carbon lamps; the latter are, however, non-focusing, so that the arc is not always at the centre of the globe; with a proper change in the size of the carbons, more light could be obtained with an 8-ampere arc than is now given by one taking 10 amperes; he illustrates and describes the methods devised by Sabouret by which all existing types of single lamps may be converted into double ones without adding appreciably to the ordinary mechanism; large arcs give a better efficiency than small ones, a subject which he intends to discuss later on.

Arc Lighting from Railway Circuits. Lond. *Elec.*, April 3.—A note stating that in Paris some street lighting has just been begun in which nine lamps are placed in series across the 500-volt mains of a railway circuit; the base of the pillar for the leading lamp of a series contains the switch and regulating rheostat for controlling the group; each lamp is in addition provided with a resistance of four ohms, which is automatically put into circuit if the lamp should fail.

Luminous Fountain. ADAMOFF system. *Elec. Eng.*, April 15.—A brief, illustrated description, the essential feature of which seems to be that the colored plates of glass are held in a frame like a large vertical wheel which revolves below the fountain, the light being reflected from the centre to the top through successive plates of colored glass.

POWER AND HEAT.

Transmission Plant. Zufikon-Bremgarten. Lond. *Elec.*, April 3.—A translation in abstract of the article mentioned in the *Digest*, April 18.

Model of the Niagara Plant. DUNLAP. *West. Elec.*, April 18.—A brief, illustrated description of a model of the power plant at Niagara Falls, which is to be exhibited at the coming exhibition in New York, and which, if possible, is to be operated by electricity from Niagara Falls, over a distance of nearly 500 miles, power being taken from one of the large generators and carried over a telegraph or telephone wire; the scale of the model is to be 100 feet to every 1.5 inches. The *Elec. Eng.* states that Mr. Stillwell suggests a plan which is likely to be executed, to deliver some of the current to condensers and to cable to Europe with it.

TRACTION.

Secondary Batteries for Locomotion. FITZ-GERALD. Lond. *Elec. Rev.*, April 3; a continuation of his article (see *Digest* last week).—He gives some advice and suggestions regarding "automotric tram cars," which also have a certain bearing on other automotric vehicles. He takes the following figures from three of the most important papers on the subject, limiting himself to that which can be verified by a comparison with other data, or by calculation and inquiry. The state of the art of accumulator traction in England is fairly represented by the Birmingham line, where the cost of working per car-mile is 41 cents, and the receipts per car-mile 31.4 cents; in Paris the cost of working is 15 cents. He says there is no use in experimenting with a car having accumulators weighing three tons, as was used in Paris, for a car weighing, with passengers, about 20.5 tons; nor is it necessary to use a battery approaching this weight; whatever cell is selected should be well adapted to withstand the shocks and vibration and it should be rejected unless an experimental trial extending over about a month shows that it complies with the following conditions: The mean ratio of power to gross weight must attain and should not exceed 1.20 watts per pound; the weigh of an accumulator per ton of traction weight should not exceed 321 pounds, and this should be able to supply 385 watts as an average for the whole run; he prefers to take 1.35 watts per pound as a minimum value; for short periods of time it should maintain a power of about 4 watts per pound; the mean rate of discharge for the whole period should attain 0.58 ampere per pound; that is, a battery weighing 60 pounds should maintain a current of 35 amperes during the whole period of discharge; for short periods it should be able to withstand a maximum rate of discharge of 2 amperes per pound; for the above rate of 0.58 ampere per pound gross weight of accumulator the apparent capacity for "certain cells used in Paris" is 3.83 ampere-hours per pound thus giving a discharge of 6.6 hours, which make three double trips, each of 11.8 miles, making a speed of 6.4 miles per hour; thus, during the first single journey the car is carrying material for supplying energy for five subsequent journeys; that is, it is hauling three tons instead of one half ton of battery; unless manutention is very laborious and costly, this condition is obviously defective; it appears to be due to the fact that no battery was available which would meet the required rate; what is required is a battery which will discharge efficiently during not more two hours; the rate of discharge in ampere-hours per pound should be increased proportionately to the diminution of weight affected by reducing the capacity from 3.83 to 2 ampere-hours; thus the weight of each cell for 35 amperes being reduced from 60 to 31.3 pounds, while the current remains constant, the current per pound in each cell would be increased from 0.58 to 1.11; maximum rate discharges for short periods would then have to be 3.5 amperes per pound gross weight; this, he thinks, is within the limits of practicability, although it is not essential; unless these figures can be met, he thinks it useless to enter into a competition with automotric tram carriages. In the next portion he intends to consider the weight of the electrolyte.

Electric Traction of Rack Railways. LEA. Lond. *Elec. Eng.*, April 3.—He calls attention to the advantages of electric traction on rack railways; they are usually in mountainous regions where water-power is likely to exist; the weight of the electric locomotive will be very much less than that of a steam locomotive, as neither tender, coal nor water are required, thus leaving a larger paying load; on such roads there is also generally a large amount of tunneling. He states that the speed will not exceed four miles per hour; the gross train weight will be 20 tons, of which about six will represent the weight of the motors and gear to develop the necessary 120 horse-power, the car having a capacity of at least 50 passengers; the net paying load would be more than about 20 per cent.; on a similar steam line with the same grade the total weight is 26 tons and the maximum net paying load is only 12.5 per cent.; the Pike's Peak line is slightly more favorable to steam traction, although far less efficient than if operated by electricity; the engine weighs 24 tons and the train 19, carrying 100 passengers, the live load being therefore 14 per cent.; the Jungfrau line would afford a very good opportunity for the use of

polyphase currents either for transmission from the source of power to the beginning of the line, or for driving the cars directly; the question of the cheapest method must be decided for each case separately. He divides rack railways into two classes, those for tourists, which are usually short and have light trains, and those forming parts of through line, on which the loads are heavy and all the other conditions very different; there are many points of great interest in the second kind, of which he gives some estimates for two cases.

Systems of Controllers. Fischinger. *Elek Zeit.*, April 2.—A very long article, with diagrammatical illustrations, on the regulation of electric cars. He discussed the various systems used in Germany for single motor equipments, and describes in great detail a method devised by him. He endeavored to use a motor which adapts itself automatically to a great extent to the requirements, by its magnetic properties and without entailing too great a weight, that is, it adapts itself to grades without requiring regulation by running slower than on level stretches; this means a magnetic field which is capable of increasing (evidently meaning an unsaturated field); curves of experimental results are given; the weakening of the field can only be carried to a certain degree in order not to be accompanied by sparking; the curves show that for 20 amperes the speed is regulated by weakening the field from 15 to 24 kilometres per hour, which covers the ordinary grades in cities; the resistance in circuit with the motor is therefore necessary only at starting and therefore only for a short distance; the loss in the regulation is very slight; in place of the step-by-step resistances, he prefers a liquid resistance, a full illustrated description of which is given; he also combines the electrical regulation with the brake, the advantages of the combination of the two being discussed at some length; it seems that the regulation is accomplished by shunting the field circuit. Diagrams are given including also one for two motors; the advantages of short circuiting the motor as a brake are pointed out; with a speed of 22 kilometres (about 13 miles) per hour the car was brought to a complete stop in the distance of 7 to 8 m, that is, in 1.2 seconds; illustrated descriptions of the brake, the liquid resistance which has been in use for over a year, and the controller, are given in detail.

Insulated Rails. Elek. Zeit., April 2.—In a long editorial the conclusions of the recent paper of Lindeck (see *Digest*, April 11, under Conductivity of Cement) are discussed, namely that rails for electric railways may be practically insulated by embedding them in asphalt. The questions arise whether the material would have the mechanical qualities necessary; whether the cost would be prohibitive; and whether insulating the rails is desirable (the main object of the insulation being to prevent return earth currents from damaging pipes). The first question can be answered only by practical experiments; regarding the second it is shown that the tie-rods would also have to be so embedded, and as they are close together it means that the whole roadbed must consist of asphalt, the cost of which would be high; the main question is whether there are any objections to insulating the rails; that the full voltage could exist on the rails is not likely as it would mean that a section is completely disconnected from another, which with the numerous cross connections is not likely to happen; to prevent the currents from returning through the earth the insulated rails must carry the whole current; to find the voltage which might therefore exist between the rails and the ground, an average case is calculated, based on the measurements of Dunning in Buffalo, and it is found that the drop in the rails might be 25 volts; a connection between the wet street and the rail, by a pedestrian or a horse, would then be quite serious; it is therefore concluded that insulating the rails, without using other means for diminishing this drop in voltage, cannot be considered as a solution to this serious question; by the use of return feeders, the earth current may be so reduced that in most cases the insulation of the rails becomes unnecessary.

Electricity for Steam Roads. Baxter. *Elec. Eng.*, April 15 (see *Digest* last week).—He discusses the relative saving on freight and passenger lines; in a passenger train the saving of the power required would be about 25.6 per cent., and nearly 8 per cent. for freight; the saving in coal would be greater as the efficiency of freight locomotives is much lower than of that of passenger locomotives; concerning all facts, however, the gain is about alike in both. He shows that the horse-power delivered on the track costs three times as much by steam as by electricity for freight work, and twice as much for passenger service; the cost of coal consumed to move a given load by electricity is about 31 per cent. for freight, and 37 per cent. for passenger work of what it costs by steam, showing that the saving is greater in frieght work; considering all things he thinks it will be about equal; with very high velocities the superiority of electricity over steam increases very rapidly, to prove which he gives the results of tests of the Empire State Express locomotive; he takes as the limiting power of the locomotive 1250 horse-power, while that of the electric locomotive is unlimited.

Astor's Yacht. Elec. Eng., April 15.—A brief description of the one which is being constructed and which will be the largest electric yacht in existence; it will be 72 feet long, 12 feet beam, and 4 feet draught; it will have twin screws and 2 motors of 50 horse-power; the maximum speed will be 16 miles an hour; there will be 480 cells which will run it for 10 hours.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulation of Pressure. Cowan and Still. Lond. *Elec.*, April 3; a reprint of the whole paper, the first part of which was noticed in the *Digest* last week; the conclusion is also contained in the Lond. *Elec. Rev.*, April 3.—In continuing the subject of the drop in the feeders, they describe compensators for measuring the voltage at the distant ends of the feeders without the use of pilot wires; a simple method is to mark the voltage which must be maintained at the station end, on the ammeter for that feeder; they also describe the method used in this country, in which the voltmeter is placed in series with the secondaries of two transformers, one being across the mains and the other in series with them. The last part of the paper is devoted to the subject of the reduction of light load losses; after discussing briefly the use of accumulators, a separate light load plant and a gas engine plant, neither of which they recommend, they describe a system which they think is the most effective and economical, which consists in adapting one of the smaller units in the station to work at a relatively high economy when lightly loaded; after discussing the steam plant for this purpose they state that the highest light-load efficiency is undoubtedly obtained with alternatives having no iron core in the armatures, but the strength and reliability of the iron-cored armatures have met with much favor; the self-induction of the alternators affords a sort of protection over the whole system and limits the current in it; they think it preferable to sacrifice some efficiency and self-regulation to obtain the factor of safety possessed by iron-core alternators; the core losses would increase appreciably as the square of the induction and if the latter could be reduced there would be a great saving in the all-day losses; if the armatures consist of two separate windings connected in parallel they might be connected in series during the hours of light load, thereby halving the induction and the core, and reducing the iron losses to one fourth of their former value, as also the exciting current; this could not be done without fluctuations in the lights; the same may be effected by the use of step-up transformers, the armature being excited to about one half its voltage, and connected in series with a transformer which would add the remaining one half to the required volts; the loss in such a transformer will, they think, be very small as compared with the saving in the alternator; such a transformer should be made a self-regulating one; the change can also be made without any variation in the light by simultaneously reducing the voltage of the step-up transformer and increasing the excitation of the alternator and bringing up its speed. The capital outlay of such an apparatus would not amount to much, and where regulating transformers are used for equalizing the pressure they can be without any difficulty adapted to do the duty of both regulators and step-up transformers; the secondary must be wound with several separate windings, which by means of a switch can be connected either in series or parallel. The results of some experiments to prove this are given in the form of curves; they discuss briefly the effects of the alteration of frequency, which results from the reduction of speed by one third; the hysteresis losses in the transformers are increased by about 25 per cent., while the Foucault losses remain about the same, and as the resistance losses are small for small currents the resulting temperature will not be high; to show that the saving in the engine is not balanced by the increased losses in the transformers, they give results of a carefully made experiment at Altrincham, in which the speed of the engine was reduced from 350 to 246, showing a saving in the indicated horse-power of 16.1 per cent., which is equivalent to 17 per cent. with a reduction of speed to ⅔ of the full speed; with large transformers and under ordinary circumstances they think the saving would be 20 per cent.; the effect of the alteration of the frequency on the meters, they claim, is not serious; it is practically negligible for Thomson meters for a ⅓ reduction, while with Schallenberger and Hookham meters it amounts to 1.5 to 5 per cent.; some curves are given showing the results of tests of the effects on the meters. With ordinary commercial arc lamps the effect of the reduction of frequency is not appreciable, "and it will be time to consider these effects upon motors when they come into practical use." Another method which they suggested is that alternating-current distribution should be carried out, not by means of sub-stations or house transformers, but by placing transformers of equal size at various points along the line, the distance between them being regulated by the load.

High-Voltage Lamps. Addenbrooke. Lond. *Elec. Rev.*, April 3.—He replied to a criticism made in the previous issue of a statement in his recent article that the advantages of high voltage increased about as the cube of the voltage; he explains this more in detail, stating that it applies to the subject as a whole and not merely to the actual cost of the feeders per yard. He furthermore states that if the advantages of using accumulators at the end of long feeders, thus reducing their section, be taken into account, which was not done in his paper, the advantages of higher voltage would be, speaking roughly and generally, proportional to the fourth power instead of third.

Islington. Elec. Eng., April 15.—An illustrated description of this station, taken apparently from the description in the English journals, noticed in the *Digest*, March 28.

Regulation of Pressure. COWAN and STILL. *El'ty*, April 15.—The beginning of a reprint in full of the paper abstracted above.

WIRES, WIRING AND CONDUITS.

Concentric Wiring. DOBBS. *Elec. Eng.*, April 15.—An article favoring concentric wiring, which he thinks "may some day become practicable"; he endeavors to formulate practical working details. It seems that Mr. Kintner holds a patent on this method of wiring. He quotes from the Phœnix (English) insurance rules regarding concentric wiring and criticises them. He suggests the use of a plain iron pipe run on the loop system, like any other conduit system, the joints being united by some metallic compound, like the plastic material used for rail bonding, for instance; 1000 feet of a ¼-inch gas pipe would have one-ohm resistance; he illustrates a method of bringing the wire out of and into the pipe at fixtures; the pipes should be well grounded and all switches and cut-outs would be single-pole. Another system would be to have the pipe insulated on the inside and pull in bare wire of a uniform size, No. 15 B. & S., making up larger ones by using several of these; thus the contractor would carry only one size of wire in stock; the objection to this is that in case of a short circuit only covered wire could be pulled in afterward.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays. According to the Lond. *Elec. Rev.*, April 3, Lord RAYLEIGH appears to think that there is no actual passage of radiant matter through the sides of the tube, as supposed by Tesla, but that another stream of radiant particles is started outside of the tube, owing to the impact of the stream on the inside.

The same journal states that Prof. LODGE had seen fluorescence excited by Röntgen rays after they had penetrated the bodies of two men standing behind each other, with their clothes on. He and his coworkers have also succeeded in obtaining impressions of the details of a damaged vertebra of an adult patient with an exposure of half an hour; they also found a "Murphy button" in the intestines of another adult patient with an exposure of 10 minutes; they used a focus tube and a powerful induction coil of the ordinary type; no further information is given.

The Lond. *Elec.*, April 3, abstracts briefly from the *Comptes Rendus* for March (no further date is given) a paper by Mr. LAFAY (the same issue of that French journal is said to contain no less than 12 communications relating to X-rays). He describes an experiment in which a leaden screen, pierced with a slit two mm wide, was placed underneath a Crookes tube about 0.5 cm from the most brilliant portion; four cm lower down there was a second screen with a five mm slit closed with silver foil supporting a platinum wire in the axis of the slit, the silver foil being connected to the negative pole of the induction coil; the rays passed between the poles of an electromagnet, whose field strength was 400 C. G. S. units, the lines being parallel to the slit; in the first experiment he obtained no certain trace of deflection, but with the plate 15 cm off there were unmistakable evidences of deflection in the same direction as would be the case with cathode rays.

The same journal abstracts a paper by Prof. J. J. Thomson and Mr. McClelland on the leakage of electricity through dielectrics traversed by Röntgen rays, read at a recent meeting of the Cambridge Philosophical Society; it contains an account of experiments made to investigate the laws regulating the passage of electricity through dielectrics transmitting Röntgen rays. The first experiments relate to the rate of leakage through different gases; they give the results relative to air; in general, though not without exception, the greater the molecular weight the more rapid the leakage; it was slowest in hydrogen and fastest in mercury vapor, the latter rate being 28 times the former; the rate in mercury vapor is interesting, as this gas offers great opposition to the passage of an ordinary electric discharge; in the halogens it is very rapid, and a tube containing charged plates in chlorine is very sensitive, and is a convenient method for measuring the intensity of these rays. The rates in air at different pressures were investigated; it was lower at low pressure, and over a considerable range it was approximately proportional at the square root of the pressure. The effect of temperature was investigated; through air the rate was lower at a very high temperature, but there was an intermediate temperature at which it was a maximum; the rate is almost independent of the voltage, it was no different at 500 than at 5 volts. In the neighborhood of the phosphorescent glass the reciprocal of the rate of leakage was a linear function of the distance from the phosphorescent patch, but at a greater distance it diminished more rapidly; the measurements were not inconsistent with the view that the rate varies with the square of the distances from a place in the neighborhood of the negative electrode. Experiments with rays that had passed through a varying number of strips of tinfoil seem to indicate that the rays are not all of one kind.

The Lond. *Elec. Eng.*, April 3, states that Messrs. ATKINSON, POOK and WILLIAMS failed to obtain the usual images of keys, coins, etc., but on exposing another plate in the same box after a trifling alteration of the apparatus, but with an entirely different set of objects, a good image was obtained, not of the second set of objects, but of the first; a similar result was obtained when an interval of eight days was allowed between the two exposures, and the box in the mean time was exposed to strong sunlight; the effect was obtained only with that particular box; further experiments are promised. Mr. GIFFORD thought that Röntgen rays were merely very long waves, though not as long as Hertzian waves; he thinks the actinic effect is due to the overtones of these waves set up in the sensitive plate.

The Edison Effect. FLEMING. Lond. *Elec.*, April 3; an abstract of a Physical Society Paper.—The Edison effect alluded to in the title of the paper is that if a metal plate is placed inside the loop of an incandescent lamp, then a galvanometer, of which one terminal is connected to this metal plate and the other to the positive lead of the lamp, will indicate a current passing from the lead to the plate. If, however, the galvanometer is connected to the plate and to the negative lead, no current passes. By connecting the poles of a condenser, first, to the two leads, second, to the plate and positive lead, and third, to the plate and negative lead, and in each case discharging the condenser through a galvanometer, he showed that after the lapse of a certain time, depending on the position of the plate, if the lamp is working at about four watts per candle, the potential of the plate falls to that of the negative lead. If the plate, instead of being inside the loop of the filament, is outside, then the time taken by the plate to acquire the potential of the negative lead is considerably longer. The space between the plate and the negative lead exhibits a kind of unilateral conductivity, for a battery having a low voltage is able to send a current from the plate to the negative lead, but not in the opposite direction. If, instead of using a cold metal plate, a second filament maintained in a state of incandescence by an insulated batter is used, then a current can be obtained between this filament and both the positive and negative leads. If the voltage on the lamp is raised considerably above that required to give one candle-power for four watts, then a current can be passed from the plate to the negative lead, while a galvanometer connected to the positive lead and the plate will indicate the passage of a current from the positive lead to the plate. When the lamp is in this condition the space between the plate and the negative lead is very sensitive to the effects of a transverse magnetic field, such a magnetic field causing a large increase in the resistance. The curve showing the connection between the current passing from the positive lead to the plate and the volts between the terminals of the lamp, is found to be discontinuous. As the volts are raised the current suddenly increases about tenfold, and it is while the lamp is in the condition corresponding to this upper portion of the curve that it is sensitive to the influence of the transverse magnetic field. By using a movable plate it has been found that the minimum current is obtained when the plate is nearer the positive than the negative lead. When an alternating current is used to supply the lamp a continuous current can be obtained passing from the plate to either of the leads. If a small platinum cylinder is made to surround each of the leads, then a current can be obtained between each of the cylinders and the positive lead, but no current between the two cylinders. The largest effect occurs when a cylinder near the end of the negative lead is connected to the positive lead. The author considers that his experiments show that the resistance of a vacuum to the passage of a discharge would be greatly reduced if the cathode were made incandescent.

In the discussion Prof. S. P. Thompson stated that a great change in conductivity and other properties took place at an exhaustion slightly greater than that in the ordinary incandescent lamps; it would be interesting to vary the size of the cathode and to see whether the effect varied with the fall of potential per unit length of the filament; also, whether the position of minimum effected was the same for all lamps, or whether it changed with the volts and the length of the filament; also, whether the minimum occurred at a certain fraction of the distance between the two leads, or at a definite distance from either of them; these points might be investigated by means of a lamp with a straight filament. Mr. Blakesley said it would be quite possible to produce an increase by means of a magnet. Mr. Serle said that a magnet affected the conductivity of the gases. Prof. Fleming in reply stated that the effects were undoubtedly largely dependent on the vacuum; in his tests the ordinary commercial vacuum for incandescent lamps was used; the screen was blackened more on the side toward the negative leg, showing that carbon was shot off from the negative terminal, and that the charge was therefore carried by these particles. In an editorial notice in the Lond. *Elec.*, April 3, it is stated that the apparatus acts as a sieve for an alternating current, sifting out the currents in one direction from those in the other, and that two such pieces of apparatus joined in parallel would constitute a rectifier; Prof. J. J. Thomson has shown that the enormously high resistance to gases is not so much in the bulk of the gas as immediately around the cathode; if the latter is raised to incandescence the trouble vanishes.

Holtz Machine. SCHMIDT and RUEHLMANN. *L'Eclairage Elec.*, March 28; a short abstract from an article in *Wied. Ann.*, vol. 56, page 166.—They endeavored to increase the output of the machine by increasing the number of points, the combs and the dimensions of the armatures of paper on the stationary discs; by doubling the number of teeth and the combs and increasing the paper sectors to 75 degrees, the output for a given velocity is increased from 20 to 25 per cent. They also studied the relation of the velocity to the output, and found that the quantity of electricity per revolution is equal to a positive quantity plus the velocity multiplied by a positive quantity (in the formula the letter v is used without explanation, but it is thought by the compiler to stand for the velocity).

Globular Discharge. Lond. *Elec. Rev.*, April 3.—The first part of an abstract of an article by Prof. Righi, in an Italian publication describing his experiments in the artificial production of globular discharges from a powerful Leyden battery, which seem to possess a certain analogy to globular lighting. A very long serial on the same subject by the same author is appearing in *L'Eclairage Elec.*, and is doubtless the same article from which the above abstract was taken.

Graphic Representation of Vector Potential. Allen. Lond. *Elec.*, April 3.—A short article showing how the distribution of electromagnetic vector potential can in certain cases be represented graphically.

Röntgen Rays. Pupin. *El'ty*, April 15.—A reprint of a very interesting paper read before the New York Academy of Sciences, on "Diffusive Reflection of Röntgen Rays." He describes a series of experiments, including the apparatus, methods and results. A powerful coil was found indispensable for strong effects; the vibrating interrupter is too slow, and was replaced by a rotary one driven by a motor and making 60 breaks per second; two condensers of three microfarads each were connected in shunt with the break and the capacity adjusted until the spark was a minimum and gave a sharp, crackling sound. Regarding the most efficient working of the tube and the critical temperature, he states that no fresh tubes are quite satisfactory, it being necessary for each new tube to first undergo an electrical treatment, which he described before that academy on March 2; he thinks Tesla's interpretation of the cause of variation of the vacuum during the discharge is probably wrong; in the electrical treatment a sufficiently strong current is passed until the tube becomes so hot that it loses its radiance; it should then be stopped and allowed to cool, the operation being repeated, which increases the vacuum and the Röntgen effect; it is not advisable to drive the vacuum much beyond the sparking distance between the electrodes on the outside; but if this point has been reached, a Bunsen flame applied to the tube will heat it sufficiently; there is a definite temperature at which the tube will work most efficiently; to maintain this currents of air may be directed against those parts of the tube which heat most; a deviation above or below this point will reduce the effect greatly; the point is so sharply defined that it looks like a critical point; below this the cathode radiation is in straight lines, and the tube fluoresces opposite the cathode; above this temperature the discharge spreads and the whole tube fluoresces; when the tube is too cool, the discharge becomes too faint; the blackening of the tube seems to be the only thing that will determine its life. He discusses the combination of a fluorescent screen with a photographic plate, for increasing the apparent sensitiveness of the latter, the fluorescence of the screen transforming most of the Röntgen rays into light; he gives the results of experiments showing how much the exposure may be reduced or the distance and thickness of the objects may be increased thereby; with an exposure of 70 minutes at three feet he photographed the whole chest, shoulders and neck of a man. Regarding diffuse reflection he quotes Röntgen as saying that regular reflection does not exist, "but that the bodies behave to the X-rays as muddy media do to light"; he (Pupin) thinks that Rood's and Tesla's experiments must be considered as a confirmation of this, and not as a demonstration of regular reflection; in his experiments he used the fluorescent screen instead of the photographic plate; the experiments are described in detail and consisted essentially in screening the rays and then placing the reflecting materials at an angle beyond the slit; not the slightest indication of an image of the slit could be detected, although there was a faint illumination; the results do not speak in favor of regular reflection; various substances were tried including metals and insulators, all producing diffuse reflection at all angles, the maximum in all cases appearing to be "when the broadest side of the reflecting object was about parallel with the fluorescent screen"; wood and other transparent insulators in general produce a stronger effect than metals; among the latter, aluminum was the weakest; the thickness of the plate increased the effect; the human body will act as a reflector. He believes that these experiments prove beyond reasonable doubt that Röntgen radiance is diffusely scattered through bodies, gases not excepted; it might be called diffuse reflection provided there is no assumption of internal inter-molecular regular reflection. X-rays may be due to a circulating motion of the ether and that the stream lines are deflected and scattered within the molecular interstices; appearances were more in favor of this view than that of the wave motion of ether; every substance subjected to the action of these rays becomes a radiator of the rays; in opaque objects in which there is less secondary radiation he thinks there is an internal dissipation which is much greater than in transparent dielectric substances; further experiments are to be made in this direction. His results connected the Röntgen rays still more with the Lenard rays; regarding the magnetic effect he suggests that it may be possible that "this magnetic effect in air is marked by the diffuse scattering of the X-rays." Among the theories proposed to account for the properties of X-rays, he calls attention to a recent essay of the late Prof. Von Helmholtz, the reference of which he gives. In a postscript referring to the priority of the use of a fluorescent screen in connection with a sensitive film, he states that he made his first experiments Feb. 7, a publication of which appeared Feb. 14.

The *Elec. Eng.*, April 15, there is a short article by Mr. Edison, giving the results of some experiments. A vacuum tube, the inside of which was coated with tungstate of calcium, gave out scarcely any of the rays, but the tube shone with a splendid white fluorescence, forming a true fluorescent lamp, which he thinks may possibly be a commercial one; he adds that "a very small bulk gave in the photometer 2.5 candle-power with an extremely small amount of energy"; the light is of a pleasant character, the spectrum showing strong red rays. Tubes with aluminum electrodes become coated with transparent aluminum which gets so thick as to become visible, diminishing the X-rays due, he thinks, to the lack of elasticity, absorbing the energy. He substitutes silicon carbide for the aluminum electrode; it does not absorb air, nor can it be melted, nor does it blacken the glass, thus allowing the voltage to be increased to the point where the glass melts; the only difficulty lies in making the contact between the carbide and the platinum wire. He believes glass decomposes; the kind used for dry plates is the most transparent, but its continuous decomposition makes it almost impossible to maintain a vacuum. Experiments were made with over 1200 substances, none of which fluoresced through thick cardboard with the arc light, a six-inch spark in air, a very high vacuum tube and the direct rays of the sun. Crystals of tungstate of calcium give off light by agitation or slight friction, thus supporting the theory that the X-ray is a wave due to concussion; with a sensitive flame and phonographic listening tubes it was "responsive to the X-ray."

Prof. Anthony, in the same journal, does not think Edison's observations regarding sound-waves (see *Digest* last week) warrant his conclusions; the deflected rays could not have been due to a true diffraction; the experiments of Le Conte seem to show that Edison's results could not be due to diffraction; other experiments show that the effect must have been due to some other cause. He suggests that some one should demonstrate whether the radiations are waves or flying particles, and if the former, what the wave-length is, and whether longitudinal or transverse, which could be shown by diffraction phenomena; a parallel beam might be obtained through two narrow slits, and it might be received by a grating, consisting of fine copper wires laid parallel to each other, which might give the diffraction phenomena and the wave-length.

E. P. Thompson in the same issue describes experiments in which he measured the candle-power of the X-rays by comparing roughly the effect of a tube and a candle on a fluorescent screen, in the former case interposing black paper; the result was that the latter gave about 400 times the effect (without the data concerning the tube and the energy the result is of no value, and it does not seem that the comparison is a correct one).

In the same journal Mr. Maver suggests that the discovery of the Röntgen rays may lead to the discovery of the action of the glow-worm; his argument is that X-rays are constantly present everywhere, but in very attenuated form, and that the fluorescent material in the glow-worm is so exceedingly sensitive to the rays that it responds to them even though they are attenuated; the insect has the power of producing luminescence at will, and it persists after death, which he thinks would agree with his theory, rather than that the insect has the power within itself to generate X-rays; it may have the power to change the chemical form of the fluorescing material at will.

Prof. Stine, in the *West. Elec.*, April 18, discusses what he considers to be the best shape for Röntgen-ray tubes; it resembles that of the pear-shaped Maltese cross Crookes tube; the cathode should be perfectly flat, and may be 0.5 to 0.75 inch in diameter, and the anode 1.25 inches in diameter; the neck where the cathode is placed should not exceed 1 inch in diameter; aluminum should be used for the electrodes; the kind of glass seems to be of little consequence; lead glass, however, is not desirable.

Prof. Michelson, in the *Am. Jour. of Sc.* for April, suggests an ether-vortex theory, an abstract of which was given in The Electrical World, April 11, page 390, where it was incorrectly stated to be from the March number of that journal.

Electricity and Water-Power. Replogle. *Elec. Rev.*, April 15.—The beginning of an article in which he discusses the subject of electricity; he states that "these articles are not designed as an engineering work, and it is not claimed that the principles set forth in them are identical with those of the most advanced thinkers."

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulator Plates. Starkey. Lond. *Elec. Rev.*, April 3.—A short note stating that in making some pasted plates they were, after being dried, immersed by mistake for several hours in a weak solution of sulphuric acid containing a small quantity of chromic acid powder in solution, and he found that they set harder and more quickly than in the ordinary acid, and apparently became deeply peroxidized; they have since behaved in a very satisfactory way after having been in regular use for some time.

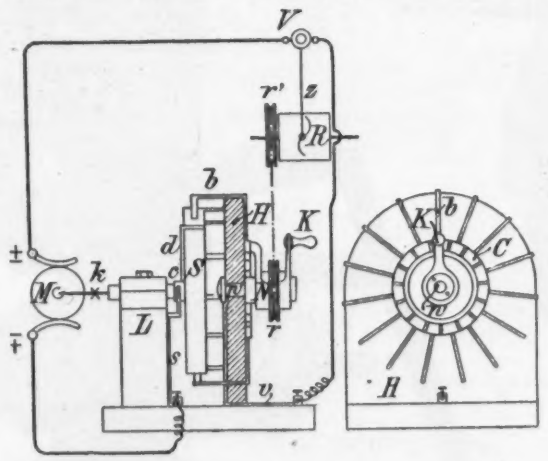
Soda Works at Niagara. *Elec. Eng.*, April 15.—A brief mention of a plant which will be started this or next month for manufacturing potash and soda; there will be about 100 tanks, and it will consume 1000 horse-power taken from the Niagara Falls plant, producing a ton a day.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Actinometry. Marechal. *L'Eclairage Elec.*, March 28.—In what appears to be the conclusion of his series on the subject (see *Digest* of last

week), he calls attention to the practical application of the actinometer. In the electric lighting industry it forms a practical instrument for rapid measurements; it is of simple and robust construction; the readings are the deflections of a needle or spot of light from a galvanometer placed in circuit with the instrument; for measuring luminous intensities a method of comparison is used, the actinometer being placed on the movable part of an ordinary photometer, the source of light, consisting of the one to be measured and the standard, are both placed on one side, each being screened off when not in use; the light is made to fall on the instrument from each in succession during about two minutes, and the deflection of the galvanometer is noted; the measurement with the standard is taken before and after the other, and if the two readings are alike it shows that the instrument has remained constant during the test; the two sources of light are placed in a plane parallel to the photometer bar, about 12 inches to one side, the instrument being moved opposite to each one so that the rays are normal; the light is proportional to the deflections; it should be well understood that the measurements give the intensity of the light "considered exclusively as a sensation of brightness." For measuring the quantity of energy which gives a maximum of light in an electric lamp, the measurement is made as before, but without the standard, an amperemeter and voltmeter being connected to the source; the actinometer indicates the slightest variations, much smaller than the most experienced eye could detect in the arc lamp; the slightest variation of the energy in the arc is shown immediately by a proportional deflection; it therefore forms a very exact method for determining the energy required for the maximum light; the instrument is a very simple one. Recent measurements of a practical character lead to the hope that this instrument will be of great service in optics and that it will become indispensable. The apparatus is made as a commercial apparatus in Paris.

Curve Indicator. Lutoslawski. *Elek. Zeit.*, April 2.—An illustrated description of an apparatus which he devised, in which the measurements may be made by self-registering instruments with ease and in a short time; all previously described methods, he says, are not sufficiently simple for general application. In principle his apparatus is a Joubert disc, only that instead of a single sliding brush there are a larger number of them; each brush in coming in contact with a wire on the periphery of the disc receives an impulse of a certain strength, which is determined by the corresponding position of the brush relative to that of the armature, which is directly coupled, or is run synchronously with the machine to be measured; a galvanometer connected with the brushes will give a deflection corresponding to the impulse; if connected in succession with all the brushes, as, for instance, if it is connected with a crank which causes it to slide over the contacts, connected with the individual brushes, the needle will have an oscillating motion; if, instead of the galvanometer, a self-registering voltmeter is used, the curve will correspond to that of the wave, if the number of contacts is sufficiently great; when the brush touches two contacts at the same time it will indicate the mean value of the two voltages, which, if the contacts are sufficiently great in number, is also a point on the curve. In the diagram, which is reproduced here, *S* is the Joubert



disc, which is driven by the machine; if multipolar it is better to drive it by reduction gears in the ratio 1 to 1½ the number of poles; the wire, *d*, is connected to the periphery of the disc and in contact with the sliding brush, *c*, which connects it with one pole of the machine; the brushes, *b*, come in contact successively with the wire, *d*, and they are connected respectively to the contact pieces, *C*, over which the crank, *K*, is moved, the crank being connected with the voltmeter. The same apparatus can be used for determining the phase-shifting between the current and the voltage; this requires a second voltmeter connected with the same drum and a second apparatus and crank; the second contact wire can be placed on the same shaft or so that it is not touched by the brushes of the first apparatus; the phase difference may be determined with great accuracy. The measurement is so rapid and simple that it may be preferable to the usual wattmeter method for determining the phase-shifting; to take these two characteristic curves involves no more difficulties than taking an indicated diagram of a steam engine, and it enables a purchaser to examine the properties of a machine without any difficulties.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Rapid Telegraph Work. Lond. *Elec.*, April 3.—The results of the recent boat race were telegraphed to the Argentine Republic, Chili and Peru, care being taken to carefully check the clocks, and it was found that the final message reached Valparaiso only 45 seconds after it reached London; it was cabled *via* Portugal, Pernambuco and Buenos Ayres, requiring no less than nine transmissions.

Pacific Cable. Lond. *Elec. Rev.*, April 3.—The first part of an article by "A Cable Expert" on colonial cable communication, and on the projected Pacific cable; it appears to be chiefly of local interest.

Telephonic Disturbances. Wietlisbach. *Elec. Eng.*, April 15.—The beginning of a reprint of the article noticed in the *Digest*, April 18.

New Books.

Westinghouse Electric Street Car Equipments. By F. L. Hutchinson and L. A. Phillips, East Pittsburg, Pa. Flexible cover; 91 pages; fully illustrated. Price, $1.

As its name implies, this book contains a complete description of the various street car motors, controllers and other car equipment apparatus manufactured by the Westinghouse Electric & Manufacturing Company. It also gives full directions for the proper inspection and repair of the same, including re-winding and connecting armatures. Also, complete information regarding the operation of the various devices, and explicit instructions for locating and remedying any electrical trouble that may be encountered. The authors have endeavored to put all directions, diagrams and illustrations into such form as to be readily understood by any ordinary man without previous electrical training, and have aimed to give practical rather than theoretical information.

The book is of a convenient size for carrying in the pocket. The writers are both engineers in the employ of the Westinghouse Company, and associate members of the American Institute of Electrical Engineers.

Johnston's Electrical and Street Railway Directory for 1896.—Containing lists of electric light central stations, isolated plants, mining plants, street railways, telegraph, telephone and district messenger companies, and manufacturers of and dealers in electrical and street railway apparatus, machinery and supplies. 832 pages; cloth. New York: The W. J. Johnston Company. Price $5.

In the production of this work, the only one of its kind in America, the object of the compilers is to furnish reliable information regarding electrical, street railway and kindred interests, so arranged and classified as to be of the most practical value and easily accessible.

Apart from the convenient classification and arrangement of its contents the Directory gives, among other things, the names of managing officers, superintendents, electrical engineers, purchasing agents, etc., of the different electrical light, street railway and other companies; the capital paid in, system in use, etc.; number of lights operated by electric light companies, and whether they furnish electric power; prices paid for city lights by 353 cities and towns; length of each street railway, number of cars operated and equipment in use.

According to the figures given in the Directory there are in the United States and Territories, Canada, Cuba and Mexico 2711 electric-light central stations, with an aggregate paid-up capital of $320,049,518, and 1140 street railways, with a total paid-up capital of $890,828,120; 828 of these street railways, with a mileage of 14,850, are operated by electricity, and 312, with a mileage of 2300, by horse, steam or cable power. The Directory also publishes a list of 7150 manufacturers, dealers, electrical engineers, etc., engaged in or catering to the electrical business, and arranged in three different ways: Geographically by States, cities and towns; classified according to lines of business, and alphabetically as a finding list. The scope of the Directory is not confined to the United States, but includes Canada, Mexico, Cuba, Central and South America.

A Well-Merited Testimonial.

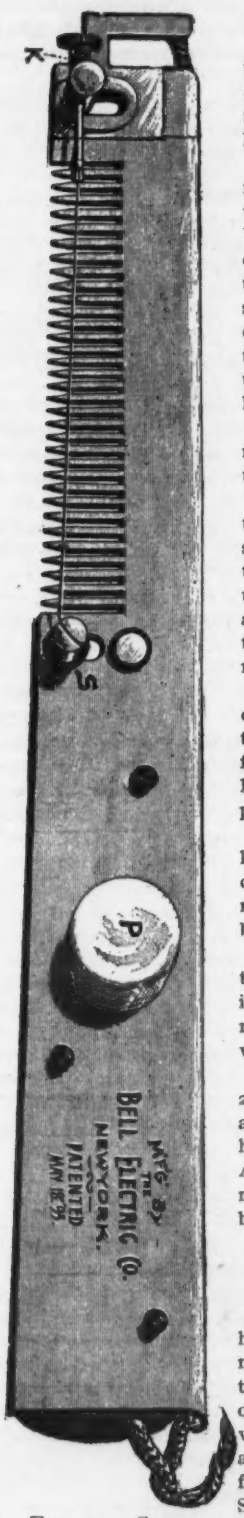
John Gordon Gray was tendered a testimonial entertainment by the former creditors of Queen & Co., at the Manufacturers' Club, Philadelphia, on the evening of April 16, in recognition of his valuable services as assignee of the company. The firm made an assignment for the benefit of creditors two years ago. The liabilities were $180,000, and the appraisers appointed by the court placed the value of the assets at $90,000. These were turned over to Mr. Gray, as assignee, and so well has he managed the affairs of the house that every cent of the indebtedness has been paid and there is $200,000 left.

The meeting was largely attended. A. G. Elliot presided, and after expressing to Mr. Gray the high regard in which he is held, presented him, on behalf of the former creditors of Queen & Co., with a set of the "Encyclopædia Britannica." Mr. Gray briefly responded. Other addresses were made by W. H. Rhawn, president of the National Bank of the Republic; Prof. E. J. Houston, Hampton L. Carson, Dimner Beeber

and Samuel L. Fox. All spoke in the highest praise of the result of Mr. Gray's work.

At a meeting on March 18 last of the board of directors of Queen & Co., Incorporated, the following gentlemen were elected officers of the company: J. G. Gray, president; S. L. Fox, vice-president; J. M. Hazel, secretary and treasurer.

Hair Singeing by Electricity.



Electric Comb.

Last year the Bell Electric Company, of New York, brought out an electric method of singeing hair, and it is stated that the system produces great stimulating effects on the hair, materially improving the appearance and enhancing its growth.

This apparatus consists of a comb of aluminum, shown in the accompanying cut, over the teeth of which is stretched a composition wire. When the button is pressed the current of electricity passes through this wire, heating it to incandescence. The hair after being cut is simply combed with this electric singeing comb, the end of every hair being cauterized, thus preventing the loss of the natural oil and the injurious drain, in consequence, upon the hair follicles.

The current of electricity penetrates the nerves and bulbs of the hair and stimulates their action.

The old process of singeing required from ten to fifteen minutes, and the work was unsatisfactory and uneven; but by the new electric process, the current of electricity being under control and the composition wire being always held in a straight line, it is impossible to burn the hair unevenly; the operation only requires thirty seconds.

When the hair is singed by the electric process, all bleeding is prevented and at the same time the stimulation received by the follicles from the current makes them vigorous and healthy, and in consequence their action perfect.

The fact that 17 per cent. of the male population in America is bald, and only ⅛ of 1 per cent. of the female, is the most conclusive argument that haircutting is injurious, unless the bleeding is checked by singeing.

The battery used on this outfit consists of two cells, in size 2½ x 9½ x 6¾ inches, encased in a wooden box 8 x 6 x 13 inches. It gives off no fumes, has no creeping salts, gives five volts and a large amperage.

The cutter wire of the electric singer is No. 26 B. & S. gauge; and requires from six to ten amperes to heat it to its work. The battery has a capacity of about 100 ampere-hours. Any degree of heat is obtainable by simply raising or lowering the rod in the top of the box.

New York Electrical Society.

The Sprague Electric Elevator Company has courteously invited the society to visit its new works at Watsessing Junction, N. J., on the evening of Friday, April 24, for the purpose of seeing how modern high-speed electric elevators are constructed and operated. In addition to the opportunities thus presented for studying the subject in all its details, Mr. Sprague has kindly consented to give a brief address on some of the more interesting features and problems of electric elevator work, especially in relation to extremely tall buildings. The most convenient train for reaching the works will be that leaving foot of Barclay Street and foot of Christopher Street at 7.50 p. m., D., L. & W. Railroad. Return trains will leave Watsessing Junction every 40 minutes up to 12 o'clock.

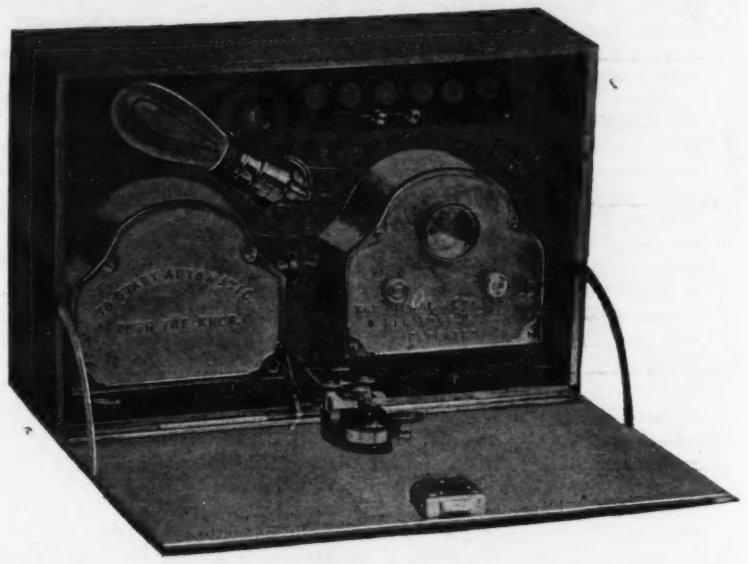
Automatic Electric Whistle.

An interesting application of electricity in a special line forms the subject of this article. It consists of a method of blowing a steam whistle automatically at regularly prescribed intervals, and is especially valuable on steamers in foggy and thick weather. It also embodies a feature which enables one steamer to signal another by blowing on the whistle Morse telegraph characters or the signals of the International Code for "rules of the road at sea."

The apparatus works with promptness and accuracy and produces the blasts on the whistle quickly and clear-cut. It is manufactured by the Signal & Control Company, Washington and York Streets, Brooklyn, N. Y.

The main apparatus is contained in a water-tight brass box, 10 inches high, 15 inches long and 5 inches through. The box contains a clock mechanism, which closes an electric circuit at stated intervals and causes the whistle to blow, the clock being thrown into action by a knob in the pilot-house and thrown out of action by one or more switches placed at convenient points on the bridge of the ship. The same switches are also used for signaling passing steamers.

The valve mechanism consists of a small piston valve operated by a pair of electromagnets, this valve admitting the steam to the large valve which controls the whistle. It is claimed that it is possible to operate these valves as rapidly as a Morse sounder. One of the essential features

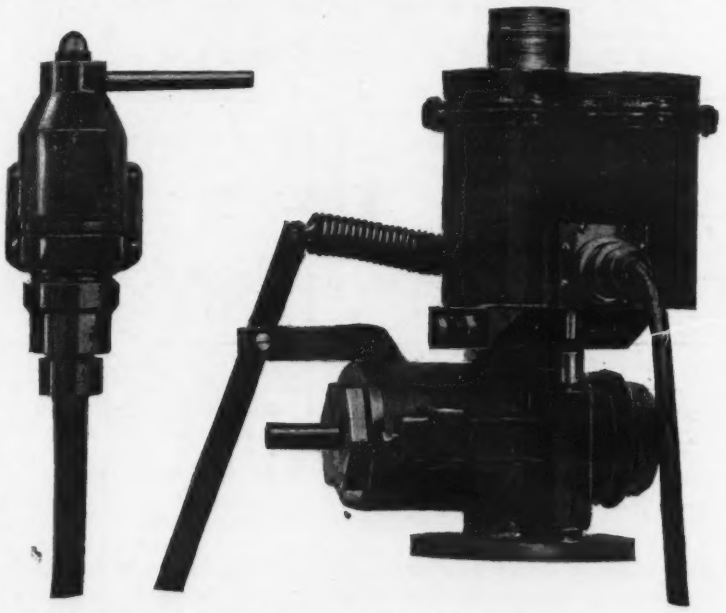


Clock Mechanism and Morse Key.

of the apparatus is that the act of blowing a "passing" signal disconnects the automatic apparatus, which is again thrown into circuit by pushing the knob in the pilot house. All of the parts are interchangeable, so that repairs can be effected without any delay should any accident occur requiring such.

On warships the Morse signaling key is placed in the pilot house or at any other convenient point, and furnishes a means of rapid telegraph signals from vessel to vessel by cipher or other secret code.

The company has perfected, in connection with this system, an



Bridge Whistle-Valve. Main Whistle-Valve.

apparatus which makes a record on a strip of paper of the actual time of the whistle blasts.

All of the parts of the automatic signal system are waterproof and tested under hydraulic pressure.

The system is patented in the United States, Great Britain, Germany, France and Italy, and has been adopted by the United States Navy and all leading transatlantic lines.

When the International Code is adopted this device will be indispensable, owing to the rapidity with which signals can be made over the old hand rope pull.

Two Specialties.

J. Jones & Son, 67 Cortlandt Street, New York, are making specialties of their baby switches and standard attachment plugs.

Baby switches are made in sizes of 15, 25 and 35 amperes capacity. The

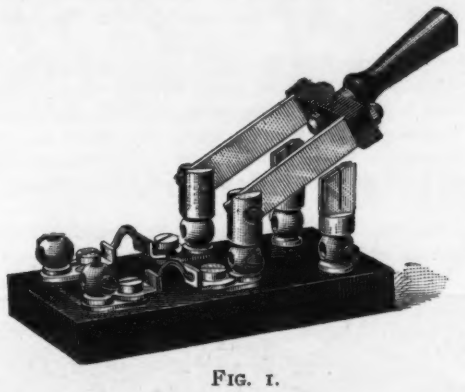


FIG. 1.

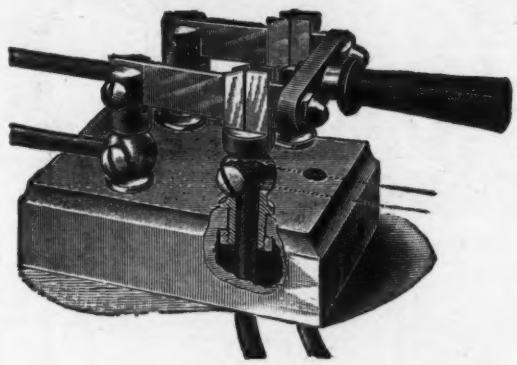


FIG. 2.

35-ampere switch shown in Fig. 1 is made in double-pole, double-pole fused and double-pole, double-throw types, and is claimed to be the smallest switch on the market, carrying capacity considered. It is especially adapted for tablet-board work, switchboard work, or in situations where space is limited. The rating of this switch will allow of an overload of 20 per cent. and it is guaranteed to keep cool. It is mounted on a black, polished slate base 2½ x 5 inches and has back connections for switchboard work. They are ornamental in design and well finished,

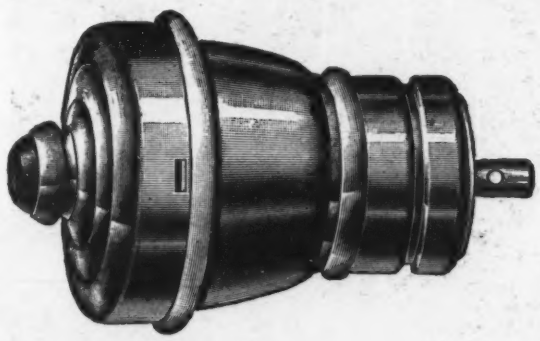


FIG. 3.

and all styles are carried in stock. Ease of wiring, substantial construction, small space and low prices are the principal qualities that commend these switches to all interested. Fig. 2 shows the manner in which the wire connections are effected.

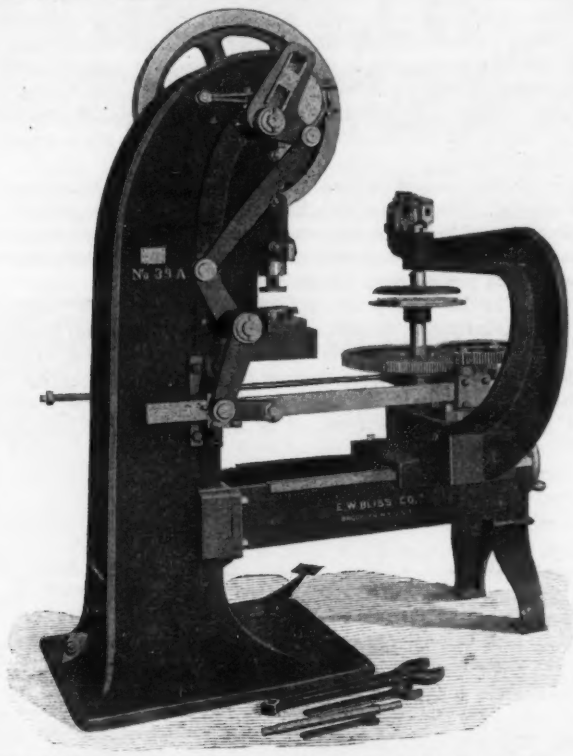
The attachment plugs (Fig. 3) are made with all standard bases and are easily wired.

New Automatic Core-Disc Notching Press.

The most advanced ideas in automatic presses for rapidly and accurately notching armature core-discs are illustrated herewith. The machine shown is made by the E. W. Bliss Co., 12 Adams Street, Brooklyn, N. Y. This company has long made automatic notching presses with index feeds, which are in use by many leading manufacturers. For the machine now introduced a number of important advantages are claimed.

The adjustment for different diameters is made by simply turning the hand-wheel shown. No alteration or readjustment of pawls or indexing parts to suit different diameters is required.

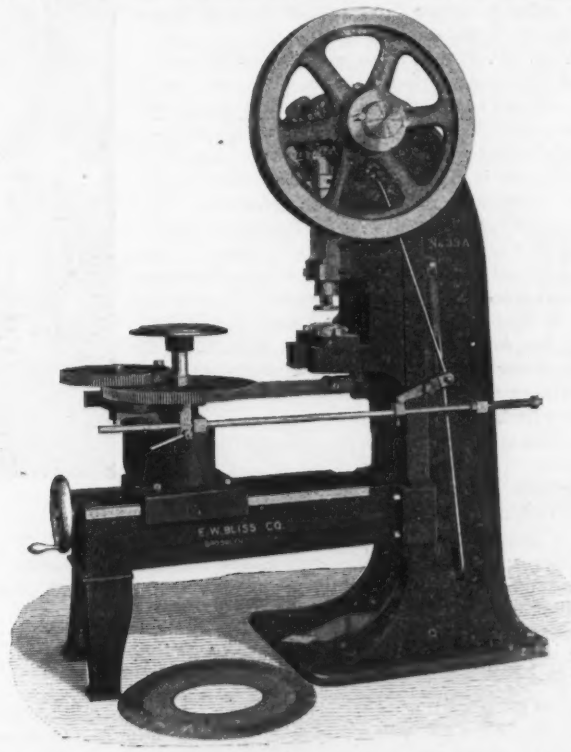
The adjustment for different numbers of notches is effected by means of change-gears instead of the usual pawl and index-plate device. One gear only need be substituted to obtain any desired alteration in the number of notches. This obviates the necessity of using a special indexing-plate for each style of disc, and effects a considerable saving, as the change-gears are comparatively inexpensive. If one notch is punched at each stroke, the number of teeth in the gear corresponds to the number of notches in the disc. If two or three notches are punched simultaneously, the number of teeth in the gear is made one half or one third respectively of the number of notches.



NOTCHING PRESS WITH CLAMPING ARM, SHOWING RACK AND PINION MECHANISM.

The index-feed is effected by means of a rack-and-pinion movement, and does not call for any adjustment for different diameters or numbers of notches.

An automatic stop is provided, which throws out the clutch (thereby stopping the machine) as soon as the disc has made one complete rotation. To start the machine the operator depresses the foot-treadle, after which he can attend to any other machines that may be under his charge, as the



NOTCHING PRESS WITHOUT CLAMPING ARM, SHOWING AUTOMATIC STOP.

work goes on automatically and stops when the last notch is cut. This makes it possible for one operator to attend several machines.

A spring stripper is used in connection with the punches in this machine, so as to leave a clear space over the die, making it easier to introduce a new disc, and holding the disc under pressure while being punched.

This obviates the necessity of using a clamping-plate over the centre of the disc, so that the time is saved which in other machines has to be spent in clamping and unclamping the disc. Such discs as have no key-notches or bolt-holes, by which to carry the disc in feeding, of course require the clamping-frame.

In the few cases where the clamping of the disc is desirable the machines are furnished with an arm (as shown in one of the illustrations), which carries a device enabling the operator by a single movement of the hand lever to do the clamping. This arm connects at its lower end with the frame, carrying the mechanism for revolving the disc from notch to notch. The upper clamping-plate, instead of having to be taken off and put on by hand, as in machines of older design, is always ready for action without handling.

The two standard sizes of this machine are designated as No. 16A and No. 39A respectively. The former weighs about 1500 pounds and will take discs of from 3 to 36 inches in diameter, which covers the requirements of most manufacturers of electric motors. It is designed to be run at from 100 to 200 strokes per minute, according to the work being done. The No 39A press weighs about 2800 pounds, and is intended for discs of from 5 to 48 inches. To meet the requirements of those who make very large discs, No. 39A is also made with an extra large clamping and indexing frame. When thus equipped it will take discs from 10 to 60 inches in diameter.

Crookes Tubes.

Although the General Electric Company commenced very early in the present year to experiment on the making of Crookes tubes for producing Röntgen rays, it is only after a long series of careful observations that the company has decided that it was ready to put Crookes tubes on the market. The Edison Decorative & Miniature Lamp Department is now ready to supply Crookes tubes of approved sizes and types. We are informed that very successful results have been obtained with the tubes already furnished by them. Experiments are being continued, in order that the most improved forms may be constantly within reach of the public.

The Standard Underground Company.

The Standard Underground Cable Company, Pittsburg, Pa., has recently made a number of important changes in the personnel of its home office, at Pittsburg, in order to better facilitate its already large and constantly increasing business.

Mr. P. H. W. Smith, who was formerly superintendent of construction for the Western sales department, and more recently assistant to Mr. J. W. Marsh, vice-president and general manager, has been appointed assistant general manager of the company. Mr. Smith's training in electrical matters was received at Lehigh University, of which he is a graduate. He has been actively connected with the Standard Underground Cable Company for a number of years in the construction and sales departments, and the advancement is well merited.

Mr. F. S. Viele, formerly of the Buffalo Railway Company, but for several years past superintendent of construction for the Western sales department, and temporarily in charge of the latter, has been transferred to Pittsburg as manager of the conduit and general construction departments. In addition to the general construction work, Mr. Viele will have under his immediate charge and supervision the conduit sales department and rubbers ales department. Mr. Viele is a graduate of the Massachusetts Institute of Technology, in electrical engineering, and his recognized ability as a trained expert in matters pertaining to insulated wires and cables makes him a valuable man to the company.

Combined Separator and Steam Receiver.

The fall of pressure that takes place between the boiler and the engine, due to the fact that the volume of steam necessary for one stroke of the engine has to be drawn from the boiler through a long and sinuous pipe during the short period of admission, which in an ordinary Corliss engine is only one fifth to one quarter of the stroke, has always been a source of annoyance to engineers.

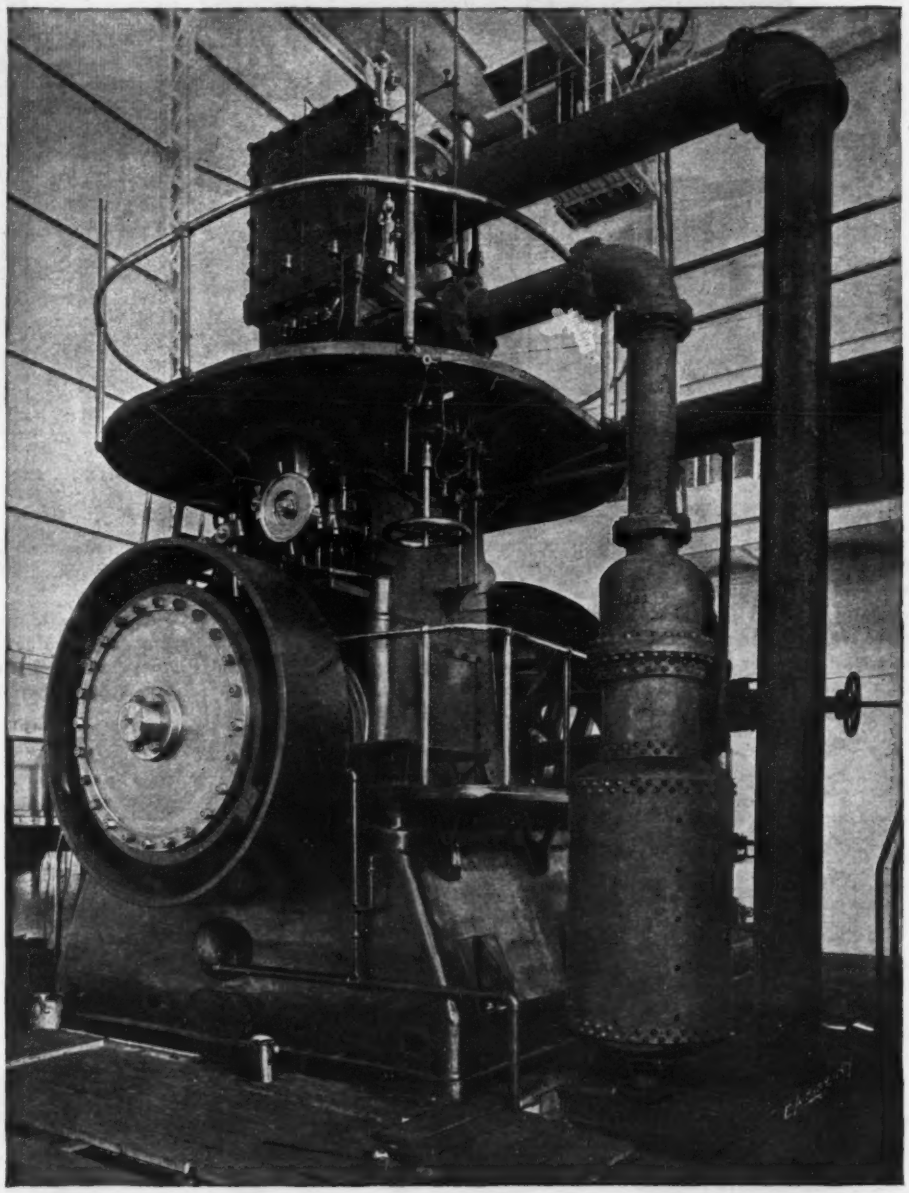
This reduction of pressure, as shown by indicator cards, generally amounts to from 5 to 10 per cent. of the boiler pressure.

Using very large steam pipes reduces the loss only in a measure, while open to the objection of increased cost, greater difficulty in keeping the joints tight, especially under high pressures, and greater liability to accidents; steam pipe explosions having unfortunately been too frequent of late.

In view of this, it has become the practice in large plants to place a large reservoir or receiver close to the engine, thus insuring a free supply of steam at substantially full pressure during admission, the boiler having ample time during expansion to again restore the pressure in the receiver.

A receiver of this kind for high pressures has been especially designed by the Goubert Manufacturing Company, of New York, manufacturers of the Stratton Steam Separator. The combination of these two appliances into one, while insuring a supply of perfectly dry steam at full pressure to the engine, economizes space and presents a much neater appearance, as well as lessens the number of joints that would be necessary if the two were used separately.

The Goubert Manufacturing Company have already supplied these combined separators and receivers to a number of large power plants,



Separator and Steam Receiver Combined.

among which may be mentioned the United Electric Light & Power Company, of New York; the West End Railway Company, of Boston, and the Nassau Electric Railway Company, of Brooklyn.

The accompanying engraving shows one of four of these Stratton combined separators and steam receivers connected to 1200-hp Westinghouse engines at the new power-house of the United Electric Light & Power Company, East Twenty-Eighth Street, New York City.

In a recent letter the chief engineer of the latter company, Mr. H. W. York, states that the separators practically remove every trace of entrained water while the receivers keep a constant supply of steam right at the throttle, which is not affected in pressure by the pulsation of the engine to an extent of over one half of one per cent.

No appreciable drop in steam pressure was noticed between the boilers and receivers even when the engines are loaded. In consequence of maintaining a constant pressure at the engine, there is practically no vibration in the steam pipe.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 18, 1896.

THE EDISON ELECTRIC ILLUMINATING COMPANY of New York has issued its financial statement for March. The report shows the following results of the month's operations, and those of the past three months, as compared with the same periods last year:

	1896.	1895.	Increase.
Gross earnings	$184,156.64	$166,683.57	$17,473.07
Net "	88,494.81	77,897.98	10,596.83
Gross earnings, three months	597,559.41	549,041.54	48,517.87
Net " " "	308,784.38	264,896.50	43,887.88

GENERAL ELECTRIC.—During the week 89,386 shares of General Electric were sold on the New York Exchange at prices ranging from 36⅞ to 38¾. The prices as compared with those of the previous week show a net change of ¾. Touching the report to be submitted at the annual meeting, Boston advices state that the final revision of figures has been made, and that the company's net income for the past year was about $1,800,000. The interest and "write-offs" will reduce this amount to about $1,200,000.

TELEGRAPHS.—Western Union fluctuated between 83⅝ and 85⅝ during the week, with a resulting net increase of one point. The total number of shares sold was 11,153.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97	99
" " " Brooklyn	100	100	102½
" " " Boston	100	135	140
" " " Philadelphia	100	131	131¼
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	33½	34
Electric Storage, pref	100	34½	35½
General Electric	100	37¼	37⅜
General Electric, pref	100	75	78
Westinghouse Consolidated, com	50	29	30
" " pref	50	53	54
BONDS.			
Edison Electric Ill., New York	105	103¼	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	92
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	204½	205
American District Telegraph	100	30	..
American Telegraph & Cable	100	93½	95
Central & South American Telegraph	100	124	127
Commercial Cables	100	138	..
Erie Telephone	100	59¾	60
New England Telephone	100	90	..
Postal Telegraph-Cable	100	87½	88½
Western Union Telegraph	100	84½	84⅝
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅝	18¾
Brooklyn Rapid Transit		22½	23¼
Brooklyn Traction	100	13	15
" " pref	100	45	47
Buffalo St. Ry	100	75	77
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	46	50
Hestonville	100	47½	48½
" pref		..	62½
New Orleans Traction	100	14	16
" " pref	100	63	66
North Shore Traction	100	29	31
" " pref	100	80	83
Rochester St. Ry	..	28	33
Steinway, Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	68	69
" " pref	100	89	..
Worcester Traction	100	15	17
" " pref	100	89	.
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	76	79
Buffalo St. Ry. 1st con. 5s	100	105	107
Cleveland Elec. Ry. 1st mtge 5s	100	95	100
*Columbus St. Ry. 1st 5s	100	96	100
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTION and street railway securities were not especially active during the week. The recent changes in the Nassau Electric Company have had no apparent effect on the securities of the companies concerned. Other securities show but fractional changes. Brooklyn Rapid Transit showed a net increase in price of 1½ at the end of the week's transactions.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 20, 1896.

THE EXCELSIOR ELECTRIC COMPANY has opened offices at 115 Broadway, having removed from 44 Broadway.

THE ANNUAL MEETING of the New England Telephone & Telegraph Company will be held in this city on May 4 next.

MEXICAN TELEPHONE COMPANY.—The annual meeting of the Mexican Telephone Company will be held in this city on May 13.

DE VEAU & CO., 32 and 34 Frankfort Street, manufacturers of telephones, have just booked an order for 315 instruments for the Hotel Matthewson, Narragansett Pier, R. I.

NEW YORK, N. Y.—The Board of Electrical Control has decided to lay conduits and subways in North Moore, West, Greenwich and Vandam Streets, and in Exchange Place from Broadway to Broad Street.

THE BENEDICT & BURNHAM MANUFACTURING COMPANY has removed its New York office from 12 Murray street to 253 Broadway, where Mr. W. E. Hungerford will be pleased to see his friends.

MR. L. COPLESTON, representing the Watertown Engine Company, of Watertown, N. Y., has opened an office at 39 Cortlandt Street. Mr. Copleston was until recently associated with E. P. Hampson & Co.

MR. JORDAN, of the firm of Schiff, Jordan & Co., manufacturers of "Ship Carbons," Vienna, Austria, is in this city. He arrived on April 15, and makes his headquarters at the new offices of the Standard Paint Company, 81 and 83 John Street.

J. H. VAIL.—This gentleman was on April 1 last appointed engineer-in-chief of the Pennsylvania Heat, Light & Power Company, of Philadelphia, also of the Edison Electric Light Company. Mr. Vail's large experience especially fits him for this responsible position.

AMERICAN SURETY BUILDING.—We are informed by Messrs. Hatzel & Buehler that Mr. Frank A. Patterson should be given all the credit for the plant designed for the American Surety Building, a description of which appeared in THE ELECTRICAL WORLD of April 4.

MEDICO-LEGAL SOCIETY.—The monthly dinner of this society was given at the Marlborough Hotel, this city, on the evening of April 15. Among the papers read was one by Dr. J. Mount Bleyer, on "The Röntgen Rays in Medico-Legal Surgery." The paper was illustrated with new Röntgen ray picture experiments.

MARRIAGE OF MR. C. I. HILLS.—On the afternoon of April 24 Mr. C. I. Hills will be married to Miss Matilda King, of Elizabeth, N. J. The ceremony will take place in Westminster Church, in Elizabeth. Mr. Hills is one of the best-known men in the electrical trade, and is now general manager of the sales department of the Perkins Electric Switch & Manufacturing Company, of Hartford, Conn. with offices in New York City.

WE ARE INFORMED by *Progressive Age* that the very large extra edition of that journal for April 15, containing the Houston, Kennelly and Kinnicutt reports on carbide of calcium and acetylene gas, was exhausted within 48 hours after the appearance of that number. The publishers immediately prepared a second edition of 20,000 copies, which is now ready for those interested in reading the reports of these experts, which can only be found in full in *Progressive Age*.

THE ELECTROSE MANUFACTURING COMPANY, now situated at 216 William Street, is again compelled to seek larger quarters, and will remove on May 1 to 127-137 North Tenth Street, Brooklyn. The company will have there some 12,000 square feet of floor space, and with a largely increased plant will be able to promptly meet all calls for Electrose goods. The New York office will be located at 190-192 West Broadway, and will be in charge of Mr. Joseph Steinberger.

MARRIED.—Miss Gertrude Van Duser Bunnell, daughter of J. H. Bunnell, was married on April 8 to Mr. Albert J. Wise. The ceremony took place at the residence of the bride's parents in Brooklyn. Miss Edith Bunnell, sister of the bride, was maid of honor. The ushers were Walter P. Phillips, Charles McLaughlin and T. C. Long. A large gathering witnessed the interesting ceremony, among those present being Mr. and Mrs. A. B. Chandler, Mr. and Mrs. G. G. Ward and Mr. and Mrs. E. A. Leslie.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., April 17, 1896.

THE AMERICAN SILK MANUFACTURING COMPANY, of this city, has bought out its most successful competitor, the Royal Silk Manufacturing Company, of New York.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY has just issued a very nice catalogue consisting of 16 pages with a most attractive cover illustrating its C-S. flush switches. This catalogue will be sent free to any one applying for it.

THE PHILADELPHIA ELECTRICAL & MANUFACTURING COMPANY, Twentieth and Jones Street, Philadelphia, in a folder just issued, illustrates and describes its P. A. lever cut-out, P. A. pull arc cut-out, P. A. lever arc cut-out, and Brush, T.-H. and Wood carbon holders.

THE PENNSYLVANIA STEEL COMPANY reports that business is in a favorable condition. The company recently secured the contract for supplying the West End Street Railway of Boston with steel rails for the entire year of 1896. The contract involves an expenditure of $350,000 on the part of the West End Company. The Pennsylvania Company has also booked other large orders, which will keep the works running full time for some time to come.

JUDGE McCOLLUM, of the Supreme Court of Pennsylvania, on April 13 handed down a decision in favor of the city in the case of the Chester Electric Light Company, Chester, Pa., which sought to restrain the Councils from making a five-year contract for lighting the city with the Beacon Electric Light Company. This case, it is stated, has an important bearing, and has special significance to cities of the third class in the State of Pennsylvania, as it allows them more liberty in making contracts for the various departments.

THOMAS H. DALLETT & CO. have received several very encouraging orders lately for standard goods and a radical increase in orders for direct-connected drill presses (horizontal and vertical) and electrical specialties. They are the only concern at the present time who have made direct-connected drill presses self-contained on one base. They have also placed a slow-speed bipolar motor of heavy design especially constructed for driving a triplex pump for an isolated plant. Their electric truck drill for taking borings from copper pig metal for essayists and chemical tests is meeting with unusual success.

WASHINGTON NOTES.

WASHINGTON, D. C., April 17, 1896.

GEN. WAGER SWAYNE, of New York, has made a statement to the House Committee on Commerce, in the interest of the Spaulding Cable Company, which is competing with the Scrymser Company for a Government subsidy for a cable to the Hawaiian Islands and Japan.

REPRESENTATIVE CURTIS, of Iowa, a member of the District Committee, has introduced a bill in Congress providing that the charter of the Metropolitan Railway Company be amended so as to authorize that company to connect with its present tracks and extend its routes, by double tracks, on certain streets and avenues; provided, that the railway be completed within six months after the passage of the act. All parts of the route north of Florida Avenue are to be underground electric and in the centre of the street.

THE WHELESS ELECTRIC LAMP COMPANY, of this city, owns the United States patents granted to Malone Wheless in 1895 and 1896, for improvements in electric arc lamps. The company is organized under the laws of Virginia, with a capital of $500,000. Mr. E. W. Creecy is general manager, with offices in the Corcoran Building. Mr. Ed MacCarthy, Superintendent of the arc lamp department of the United States Electric Lighting Company, of Washington, reports great satisfaction with the working of the Wheless arc lamp for street (municipal) lighting.

THE ECKINGTON ROAD has placed an order with a Baltimore firm for 10 compressed air cars to run from Fifteenth and G Street to Brookland. They will be in operation in a short time and then the trolley from Florida Avenue to Brookland will be entirely abandoned. The Eckington electric power-house will be converted into a compressed air power-house, and if all the claims of the company building the cars hold good, the Eckington road will shortly have a modern rapid transit line without changing their present tracks. The company manufacturing the cars are under contract to operate them for one year, when the Eckington Company can accept or reject them. They are modeled after the expensive motor cars adopted by the Mount Vernon road, which cost several thousand dollars each, and they are claimed to be especially adapted for heavy hauling and fast running. The Eckington and Belt lines have been consolidated and both roads are running under the direction of the Baltimore syndicate, which owns them. As the syndicate owns larger interests in Baltimore than in this city, the central offices of the Belt and Eckington systems will be in Baltimore, but a local headquarters will be established here. If the compressed air soon to be introduced on the Brookland branch of the system is a success the syndicate will then enter into a contract with the same manufacturers for the equipment of the Belt line branch. The contract may be given this coming Summer if the air cars are apparently a success from the start. The owners of the road think that compressed air double-decker cars would prove a source of large revenue during the Summer on the Belt branch. The idea is to have double-decker cars built for pleasure parties, lighted with electricity and provided with a space for musicians. The cars will be chartered for an evening to a party of excursionists at a reasonable rate to make continuous trips around the Belt branch in the evening. The road will not be blocked by Congress in making these projected improvements, as it can secure the authority from the Commissioners to introduce the compressed air. The Commissioners are in favor of its introduction.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., April 17, 1896.

THE WASHINGTON CARBON COMPANY, of Pittsburg, Pa., will be represented at the New York convention by J. S. Crider, A. H. Mustard and B. H. Blood.

ALL THE UNDERGROUND CABLES to connect the Postal Telegraph-Cable Company's magnificent offices in Pittsburg, through the underground district to the overhead lines outside of said district, were furnished and installed by the Standard Underground Cable Company. The cables go out in two different directions, and comprise all the circuits eastward and westward from Pittsburg. The Standard Underground Cable Company is now laying some large underground cables for the Western Union Telegraph Company in Pittsburg, taking in most of the Western wires of that company.

LION KILLED BY ELECTRICITY.—Nero, a pet lion owned by Bob Fitzsimmons, the prize-fighter, was killed in Cleveland, O., by electricity in a peculiar manner on the night of April 16. The lion was placed on the roof of Rumsey's natatorium, where he could keep cool. Several electric light wires cross the roof. After dark Fitzsimmons and some friends went to the roof to see if the animal was all right. The lion on hearing his master's voice sprang toward him, and in so doing his collar came in contact with one of the wires. The beast gave a roar, and with a bound leaped off the roof and dangled at the end of his chain dead. Fitzsimmons tried to free the animal and received a painful shock, but was not injured.

MR. R. S. WARING, formerly prominently and actively connected with the Standard Underground Cable Company, and the original owner of many of its patents, recently entered suit against Mr. George Westinghouse, Jr., to recover the value of 10,000 shares of the company's stock. Mr. Waring claimed that the stock was transferred by himself to Mr. Westinghouse at the time that Mr. Westinghouse became connected with the company, in March, 1886, and was to have been held in trust and for his benefit. Mr. Westinghouse said substantially that the stock had been given him outright, to secure his active interest and influence in favor of the company, which was then a new undertaking, and that there was no agreement or understanding that he held the stock for Mr. Waring, and that nothing is due to Mr. Waring on account thereof. The case was brought to a sudden termination on the 9th inst., when the plaintiff withdrew his suit. The testimony on the main issue—viz., whether Mr. Westinghouse should account to Mr. Waring for the stock—was it is said, largely in favor of Mr. Westinghouse up to the time the suit was withdrawn.

COLORADO NOTES.

DENVER, COL., April 14, 1896.

RÖNTGEN RAYS.—Prof. Rowe, of the University of Colorado, recently delivered an interesting lecture on Röntgen rays in one of the Denver churches.

THE COLORADO TELEPHONE COMPANY will extend its system from Aspen to Glenwood Springs. Work will begin in a few weeks. This connection will give Glenwood telephone communication with Denver *via* Aspen.

NEW IDAHO SPRINGS PLANT.—The management of the Stanley mine at Idaho Springs has decided to install an electric light plant, power for which will be furnished by water. Beside lighting its own property, the company proposes to sell lights in Idaho Springs.

THE DENVER, GLOBEVILLE & GOLDEN ordinance has passed the City Council. The franchise gives the company the right to build an electric railway through certain streets in North Denver to Globeville. The company agrees to pay into the city treasury 2 per cent. of the gross receipts for the first five years and 3 per cent. thereafter.

THE GREENLAND ALUMINUM, OIL, GAS & LARD COMPANY has just been incorporated. It is proposed to produce aluminum from clay found near Greenland, Colo., by an electrical process invented by H. D. F. Schwan, of Kansas City. The promoter of the company is Joseph H. Baxter, of Denver, and the money is to be furnished by St. Louis capitalists. It is said that if tests of the clay are as successful as those interested predict, a $50,000 plant will be erected at Greenland.

NEW INCORPORATIONS.—A second company has been formed to construct an electric railway into the West Creek mining district. It is named the West Creek Electric & Toll Road Company, and the incorporators are B. B. Clawson, Arthur O. Williams and Sidney Williams. It is proposed to start the line at South Platte, on the South Park steam railway, and the route will follow the old grade, up the South Platte River, passing through Pemberton, Woodland Park and thence to Divide.

MOVED THE ELECTRIC LIGHT PLANT.—The authorities of Lafayette, a town within 20 miles of Denver, found that they made a mistake when they tried to intimidate John S. Spencer, the owner of the local electric light plant. They made an agreement with him for a certain number of lights for public illumination, but when the wiring had been completed they began to quibble about the contract, and refused to take the number of lamps agreed upon. Mr. Spencer was disgusted with their action, and concluding that it was useless to negotiate further with them, chartered two freight cars and had the entire plant of machinery carried to Walsenburg, Colo. An arrangement has been made by which a power-house will be erected at that place, and power will be furnished to the Cameron and Sunshine mines, which heretofore have used steam power.

THEFT OF TRANSFER SLIPS.—A curious point of law was made in the trial of Louis V. Law, charged with the theft of 4000 transfer tickets from the Denver Tramway Company. The evidence established the fact that the defendant entered one of the company's cars and took the tickets in question. He was disposing of them to dishonest conductors when he was arrested. At the trial the prisoner's counsel moved for his discharge, on the ground that he was not guilty of either burglary or larceny. The court thereupon dismissed the charge of burglary, but held Laws for larceny. In a carefully prepared

opinion the court showed that the statutes relating to burglary, in enumerating the places where the crime might be committed, included "railway cars"; but he held a street railway car was not a railway car in the meaning of the law. Laws was convicted of larceny and was sentenced to 30 days' imprisonment.

THE UNION RAILWAY COMPANY has submitted to the City Council of Denver a proposed ordinance which it asks to have adopted. Under its provisions the company would have the authority, after making an agreement with the Denver Cable Railway Company, to change all existing cable lines into electric roads. It would also have the right to extend these lines and to build additional roads. For these privileges the company agrees to pay 3 per per cent. of the gross receipts for ten years, and 5 per cent. thereafter. The incorporation papers of the company have just been filed. The capital stock is $1,000,000, and the incorporators are: Benjamin A. Jackson, of Providence, R. I.; William W. Field, Harlan P. Parmelee, Hermann H. Dunham and G. C. Jackson, of Denver. The directors are: Marsden J. Perry, of Providence, R. I.; Samuel P. Colt, of Bristol, R. I; Henry A. Carey, New York, N. Y., and Richard A. Bolles, of El Paso County, Colo.

CANADIAN NOTES.

(From Our Own Correspondent.)

MONTREAL, Can., April 16, 1896.

HARROW, ONT.—The South Essex Electric Railway Company has applied for an Ontario charter to build a line from Amherstburg to Harrow, Ont.

CAMPBELLTON, N. B.—The Campbellton, N. B., Electric & Telephone Company is enlarging its plant, and contemplating an extension to Dalhousie.

OTTAWA, ONT.—An electric railway is projected to extend from Bell's Corners to Richmond West, a distance of 10 miles. John Moodie is one of the promoters.

NIAGARA FALLS, ONT.—The Niagara Falls Park & River Electric Railway carried last year 499,015 passengers, which is a large increase over 1894. The receipts were $65,784, and cost of operation $40,630.

SHERBROOKE, QUE.—J. E. Flood and J. W. Burke, of New York, were in Sherbrooke recently, to make final arrangements with the City Council and R. W. Heneker for the commencement of the electric street railway in that city.

TORONTO, ONT.—For some time negotiations have been pending for the purchase of an electric railway franchise on the Niagara Peninsula. It is said that a syndicate composed of capitalists from Toronto, Montreal and New York is now being formed to secure the franchise, the intention being to build the line at once.

QUEBEC, QUE.—Capitalists from the United States, including J. N. Brown, of Baltimore, President of the Maryland Trust Company; J. Shear and W. J. McCracken, New York, and F. O. Blackwell, C.E., are interested in the Quebec electric street railway scheme. The absorption of the electric light company's plant and the Quebec, Montmorency & Charlevoix Railway is contemplated.

MONTREAL, QUE.—The application of the Canadian Electric Railway & Power Company, which proposes to build an electric line from Montreal to Windsor, has been refused by the Railway Committee of the Dominion Parliament. Efforts are being made to restore the bill to the order paper. The promoters, who are chiefly Toronto capitalists, are George W. Beardmore and W. H. Cawthra, Toronto; James K. Osborne and Lyman M. Jones, Winnipeg.

HAMILTON, ONT.—The promoters of the Hamilton Radial Electric Railway Company have secured the right of way over the Beach, crossing the canal by the new government bridge on the other side of Hamilton Bay. It is the intention of the company to start building early in the Spring, and to have the line completed as far as Burlington in June. The officers of the company are: Alex. Turner, President; Thos. Leather, vice-president; W. W. Osborne, secretary; W. A. Wood, treasurer. Directors: A. Zimmerman, Geo. Lynch Staunton and John Moodie.

General News.

NEW INCORPORATIONS.

THE CROWN POINT TELEPHONE COMPANY has been organized in Indianapolis, Ind., by George W. Fischer, with a capital stock of $10,000.

THE CHELSEA TELEPHONE COMPANY, Chelsea, Mich., has been incorporated with a capital stock of $10,000, by Lynn L. Gorton and A. W. Wilkinson.

THE EGYPT ELECTRIC COMPANY has been incorporated at Cairo, Ill., with a capital of $40,000, by William Kluge, Henry Hassenjaeger, Albert Lewis and Calvin V. Neff.

THE METROPOLITAN RAILWAY COMPANY, Portland, Ore, has been organized with a capital stock of $6000, by W. Minor, Joseph N. Teal and W. W. Cotton, Portland, Ore.

THE CHEROKEE TELEPHONE COMPANY has been incorporated at Cherokee, Ia., with a capital of $25,000. The incorporators are James F. Meart, R. L. Robie, A. B. Ross, W. H. Lysaght and W. A. Sanford.

THE REDWOOD CITY ELECTRIC LIGHT COMPANY, Redwood, Cal., has been organized with a capital of $50,000. The incorporators are George H. Rice, Robert Brown, Ludwig P. Behrens, George C. Ross and others.

THE DECATUR LIGHT, HEAT & POWER COMPANY, of Decatur, Ill., has filed articles of incorporation. The capital stock is $300,000. The incorporators are John W. Yantis, Wallace E. Walker, and C. W. Steward.

THE OLD FORGE ELECTRIC LIGHT, HEAT & POWER COMPANY, Old Forge, Pa., has been incorporated with a capital stock of $5000 by Samuel Brodhead, Jr., Thaddeus J. Stewart and William Rapp, Old Forge, Pa.

THE LODA ELECTRIC LIGHT, WATER & TELEPHONE COMPANY, Loda, Ill., has been incorporated by E. S. Sherdon, W. L. Kinsman, N. P. Goodell, J. T. Urest, A. Smanson, and Frank F. Butzow. The capital stock is $10,000.

THE CORDOBA LIGHT & POWER COMPANY has been organized in Portland, Me., with a capital stock of $1,000,000. The incorporators are Francis M. Edwards, Boston, Mass., William W. Gooch, New York City, and Clarence Hale, Portland, Me.

THE H. P. BALL MANUFACTURING COMPANY, of Brooklyn, N. Y., has been organized to manufacture electric appliances. The capital stock is $20,000, and the directors are John E. Ball, Christopher B. Keough and M. A. Vosburgh, of Brooklyn.

THE OSWEGO ELECTRICAL COMPANY, of Oswego, Kan., has been organized with a capital stock of $25,000, to suppy light and heat. The incorporators are Samuel Carpenter, Jr., Thomas McNeff, David Jennings and W. F. Giltney, Oswego, Kan.

THE BERGEN BEACH LIGHT & POWER COMPANY, New York, N. Y., has been organized with a capital stock of $25,000. The directors are Van Wyck Rossiter, of Nyack; H. H. Porter, Jr., of Lawrence, Queens County, and Frederick Giblin, of Brooklyn.

THE DAVENPORT CONSOLIDATED GAS, ELECTRIC LIGHT & STEAM HEATING COMPANY, with a capital stock of $400,000, has been incorporated in Davenport, Ia. The incorporators are E. C. Walsh, M. A. Walsh, J. W. Walsh and A. E. Walsh.

THE SOUTHWESTERN TELEPHONE & TELEGRAPH COMPANY has been organized in Little Rock, Ark., by Arthur F. Adams, James A. Chambers and Charles J. Glidden, with a capital stock of $10,000, with the privilege of increasing it to $1,000,000.

THE DIEHL MANUFACTURING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $200,000. The company will manufacture and sell electric motors, dynamos, lamps and general electrical apparatus. The incorporators are Edwin H. Bennett, Edwin H. Bennett, Jr., Bayonne, N. J., and Frederick G. Bourne, New York City.

TELEGRAPH AND TELEPHONE.

ST. LOUIS, MO.—This city will soon be connected with the long-distance telephone system.

JACKSON, TENN.—The Citizens' Telephone Company, of this place, has been granted a charter.

LOWELL, MASS.—The Davis Telephone Company has been granted a location for its wires in this city.

GREENBUSH, N. Y.—Efforts are being made by the citizens of this place to secure a telephone exchange here.

BAGLEY, IA.—It is proposed to extend the lines of the Perry Telephone Company to Bayard and other places in this vicinity.

WAYNESBORO, PA.—The Pennsylvania Telephone Company is extending its lines from this place to Greencastle and Mercersburg.

MILLERSBURG, KY.—This place is now in long-distance telephone communication with Lexington. The line will be extended to Carlisle.

ELLSWORTH, ME.—The New England Telephone & Telegraph Company will soon begin the extension of its lines from Ellsworth to Sullivan.

GRAND RAPIDS, MICH.—The Bell Telephone Company has reduced its rates from $48 to $24 for business purposes, and to $18 for residences.

DANVILLE, KY.—Robert and Glen Eddy, of this city, have been awarded the contract to build a telephone line between Hustonville and Danville.

ALBERT LEA, MINN.—The Northwestern Telephone Company contemplates extending its lines from Jordan to this place, by way of Montgomery.

CHELSEA, MICH.—The Chelsea Telephone Company has been recently organized for the purpose of establishing and operating a telephone exchange.

BARRE, VT.—A franchise has been granted to Geo. H. Almon to establish a telephone exchange in this place, which has a population of 10,000 inhabitants.

RIDGWAY, PA.—The Long Distance Telephone Company is making arrangements to build a telephone line from this place to Kane during the coming Summer.

BURLINGTON, WIS.—A franchise has been granted to the Burlington Telephone Company for the construction and maintenance of a telephone exchange in this city.

PARKERSBURG, IA.—Two telephone companies, the Iowa Union and Cedar Valley, are putting up lines in this place to connect with points east, west, north and south.

OTTAWA, O.—The Ohio Telephone Company, of this city, has sold its line and franchise to C. P. Godfrey, J. C. Jones and G. W. Risser, of this city, who will organize a new company and improve the service.

MONTPELIER, VT.—On Easter Sunday an experiment was made in transmitting Easter music from the Church of the Messiah in this city to St. Johnsbury and Springfield. A transmitter was placed near the organ, and both the music and the sermon of the pastor were distinctly heard at the two places.

MONTPELIER, VT.—Geo. H. Almon has been granted a telephone franchise in Waterbury, Vt. Mr. Almon expects to get a similar franchise from this city at the next meeting of the Town Council. It is Mr. Almon's intention to connect all of the neighboring towns by telephone during the coming Summer.

BOSTON, MASS.—According to a circular issued by the American Bell Telephone Company respecting the 21,500 new shares of stock to be issued, the privilege is given to each stockholder of record on March 31 last, to buy new stock in the proportion of one share of new for every ten previously held. The right to subscribe for the new shares will expire on May 16 next.

Electric Light and Power.

BROADHEAD, WIS.—The citizens have voted to purchase an electric lighting plant.

COLUMBUS, O.—The proposition to issue bonds for a municipal lighting plant has been carried.

LEBANON, KY.—The electric light plant of this place, which cost originally $30,000, has been sold at commissioner's sale for $10,000.

NORRISTOWN, PA.—There is some talk of establishing a municipal electric light plant in this city, and the Council is now considering the matter.

IRVINGTON, IND.—It has been decided by ballot in this town to have a municipal electric light plant. Eighty-one women voted for the improvement.

MARQUETTE, MICH.—The Westinghouse Electric & Manufacturing Company has been given the contract for the electric light and power plant in this place.

HARRISBURG, PA.—The annual meeting of the Electric Light Association of Pennsylvania was held in this city on April 9. There were about a dozen representatives present.

RAHWAY, N. J.—The Rahway Electric Light & Power Company's plant including that of the Union & Middlesex Traction Company's line, is to be sold by the receiver on April 28.

SPRINGFIELD, ILL.—It is stated that the municipal electric light plant cost the city last year from $8000 to $9000 more than it would cost for the same amount of light from a private company.

SCHOOLCRAFT, MICH.—The City Council on April 14 granted Rheubottom & Bond, of Union City, Mich., a 15-year franchise for an electric lighting plant, the same to be completed within six months.

CHICAGO, ILL.—Plans are being drawn up for the erection of an electric power plant for the University of Chicago. The electric light will be introduced into all of the buildings and on the campus.

STAMFORD, CONN.—The hoods of the electric arc lights are used quite extensively by sparrows in building their nests, and these incumbrances have given the Stamford Electric Light Company considerable bother.

ST. LOUIS, MO.—A new racing track, which is lighted by electricity and racing carried on at night, was opened on April 15. It is stated that every move of the horses could be discerned without the aid of glasses.

DEXTER, MICH.—Wm. Curlett, Alfred Davis and Benj. F. Arksey have been appointed as committee by the Council to investigate various systems of electric lighting, and to receive propositions for the proposed plant here.

BALTIMORE, MD.—The new electric light subway for the Brush Electric Light Company is about complete. It is 9369 feet long, and has two ducts laid in concrete. Each duct is a 4½-inch wrought-iron pipe cement lined to a diameter of 3 inches.

FRESNO, CAL.—On the evening of April 7, electric current, generated at the power-house on the San Joaquin River, was turned on for the first time. This was to test the wires and the system, and it is stated that everything worked satisfactorily.

SALINA, KAN.—The Salina Electric Light & Power Company has disposed of all its property and franchises in this city to a company of Leavenworth capitalists. A new company will be reorganized and considerable extensions in the plant will be made.

CORUNNA, MICH.—Last Fall the city voted to bond itself for $30,000 for water works and electric lights, but the Mayor refused to sign. Rev. A. C. Marshall, the nominee for Mayor of the faction favoring public improvements, was elected at a recent election.

The Electric Railway.

ST. LOUIS, MO.—The directors of the Southern Electric Railway Company have decided to issue $200,000 worth of bonds for improvements.

PHILADELPHIA, PA.—The Supreme Court has confirmed the right of the Fairmount Park Transportation Company to construct an electric railway in Fairmount Park.

BROOKLYN, N. Y.—All of the elevated and surface lines of this city will make the rate to Coney Island from the Bridge 10 cents, in order to compete with the Nassau Electric Railway Company.

NEW HAVEN, CONN.—The New Haven Street Railway Company will at once extend its lines to Centerville, a distance of about three miles, paralleling the Northampton division of the New Haven Railroad.

SEA ISLE CITY, N. J.—A project is on foot by Philadelphia, Camden and South Jersey capitalists to construct a line of electric railways from Atlantic City to Cape May Point. The new improvement will cost $250,000.

SING SING, N. Y.—The trolley line is to be extended from this place to Pleasantville, a distance of about five miles. The work will be commenced at once and it is expected that cars will be running during the Summer.

EXTENSION ABANDONED.—The Waterbury Traction Company of Waterbury, Conn., has made formal announcement that on account of unjust burdens imposed by the city it will not extend its system to Waterville or in any other direction.

DAYTON, O.—The Inter-Urban Electric Railway Company is planning the construction of a road to unite Troy, Tippecanoe, Dayton and the intermediate points. John T. Koop, Dr. W. R. Thompson, Frank Worman, all of Troy, are said to be interested.

DELFORD (P. O. HACKENSACK), N. J.—The survey for the proposed trolley line has been completed. The route is from Fairmount, at Hackensack, over private land until a point is reached near Oradell, thence to Westwood, Hillsdale and Park Ridge.

PLAINFIELD, N. J.—A movement is on foot for the extension of the trolley line from Elizabeth to this city, and ample financial support for the same has been secured. All that is required now is the consents of the property owners for the building of the lines.

BINGHAMTON, N. Y.—The Homer Traction Company has made an arrangement with the Delaware, Lackawanna & Western Railway Company, which gives it the privilege of carrying milk from McGrawville to Cortland. At least 300 cans of milk will be carried per day.

INJUNCTION CONTINUED.—The injunction restraining the Prospect Street Railway Company, of Chester, Pa., from crossing the tracks of the Philadelphia, Wilmington & Baltimore Railroad Company has been continued until June 1 by agreement of all parties interested.

BOSTON, MASS.—The West End Street Railway Company will make extensive track renewals during the present year, and with this object in view has placed orders for over $300,000 worth of steel rails to be delivered as needed. Ninety-three pound rails will be used in the reconstruction work.

BROOKLYN, N. Y.—P. H. Flynn, president of the Nassau Electric Railway Company, of Brooklyn, resigned his position on April 11, and Mr. Albert S. Johnson, of Cleveland, O., was elected his successor. Mr. Tom L. Johnson, also of Cleveland, was elected treasurer, and James C. Church was elected secretary.

NEW YORK, N. Y.—It is reported that the Third Avenue Railway Company has secured control of the Twenty-eighth Street cross-town line, and proposes to equip it with electric power. It is also reported that the same company will equip the Forty-second Street & Boulevard line with the underground trolley system.

Personal.

MR. F. H. DAVIS, who has for the past seven years been connected with the engineering department of the Westinghouse Electric & Manufacturing Company, Pittsburg, has resigned his position to accept one with an important mining company in South Africa. Mr. Davis has already left America for his new field of labor.

Trade and Industrial Notes.

NEW HAVEN, CONN.—The Superior Court has ordered a final dividend of 1-5 per cent. on the claims against the Ansonia Electric Company, which failed some months ago, with liabilities of about $260,000.

KNICKERBOCKER ENGINE.—The Knickerbocker Engine Works, Hartford, Conn., has just issued a neat catalogue of its Knickerbocker engine, which was described and illustrated in our columns last week.

RAILWAY PLANT.—M. T. Davidson, Brooklyn, N. Y., is building for the power house of the Baltimore & Catonsville Railway Company five vertical Davidson twin air-pumps, ten heavy-pressure pumps and four small pumping engines.

ELECTRIC GAS LIGHTING.—The April catalogue of the Electric Gas Lighting Company, 195 Devonshire Street, Boston, Mass., is of artistic execution and complete. This company manufactures an extensive line of domestic electrical supplies.

THE NATIONAL ELECTRICAL EXPOSITION COMPANY has recently awarded the following contracts: To William Andrews, steam piping and fittings; to Garrett Wright, boiler and engine foundations; to J. E. Phelps, exclusive catalogue privilege.

PIPE COVERING.—The New York Fireproof Covering Company, 121 Liberty Street, New York, has issued a neat folder, giving a few unbiassed opinions showing the value of this company's pipe covering. This covering is made in sections three feet long to fit any size pipe, and is easily applied.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received the contract to furnish the New Britain Knitting Company the steel work for its new boiler plant. The roofs of the buildings will have steel trusses throughout, and in designing these buildings everything has been so constructed as to render them thoroughly fireproof.

PITTSBURG, PA.—It is reported that the Westinghouse Electric & Manufacturing Company has purchased the largest group of copper mines in Arizona, and obtained possession of the International Smelting Company's plants nearby. These plants will be enlarged in order to supply the company with copper for the manufacturing purposes of the Westinghouse Company.

LANGSTADT & CROSSWELL, "manipulators of electrical energy" and dealers in kindred apparatus, Appleton, Wis., have issued a neat pamphlet descriptive of their business and the various apparatus dealt in. They trade in dynamos and motors of all makes, install isolated plants, carry electric heating apparatus, and have a regular house and factory wiring department.

LIGHTNING ARRESTERS.—"Current Practice in Protecting Electrical Apparatus Against Lightning" is the title of catalogue No. 146, issued during March by the Westinghouse Electric & Manufacturing Company. The descriptive matter was written by Alexander Jay Wurts. Many testimonials are given concerning the value of the Wurts lightning arrester, which is manufactured by the Westinghouse Company.

THE LEWIS TOOL COMPANY, 44 Barclay Street, New York, in its illustrated catalogue, gives full descriptions and clear illustrations of Lewis's patent vises and other tools manufactured by the company. Every class of vise is manufactured by this company, for all purposes. They are made of the best materials, and are strictly first-class in finish and workmanship. These goods possess considerable merit.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that it is now in a position to quote specially low prices on Paranite cables of extra large carrying capacity up to a million circular mils. It is also able to make very prompt deliveries, as the nearness of the Indiana Company's factory precludes the possibility of delays in transit. Paranite telephone cables from 10 to 500 conductors are also in large demand, and the Electric Appliance Company has secured a number of good orders.

THE SUPPLY MANUFACTURING COMPANY, Thirty-second and Smallman Streets, Pittsburg, Pa., manufacturers of light and power supplies, also reconstructors of dynamos and motors, recently received a large order from the Illinois Steel Company, of South Chicago, for dinky controllers. Mr. Stevenson, of this company, reports business exceedingly good, especially in the repair department, his company being compelled to run its factory day and night. This company has first-class facilities for such work, occupying 8640 square feet for manufacturing purposes.

CASUALTY INSURANCE.—A number of gentlemen interested in electrical enterprises have organized in Scranton, Pa., a mutual company for the purpose of securing insurance against employers' liability, public liability and boiler explosions, at as near cost as possible. The stock casualty companies have increased the rates so materially that insurance with them is practically prohibitory. The name of the organization is the Electric Mutual Casualty Association, with home office at Scranton, Pa. Horace E. Hand is president; W. B. Rockwell, vice-president; Newton Jackson, secretary, and G. M. Halstead, treasurer.

Business Notices.

AN INVENTOR can have a practical, patented, electrical novelty placed on the market by communicating with Box 676, Syracuse, N. Y.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 14, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

558,027. ARMATURE WINDING; A. F. Barchelder, Schenectady, N. Y App. filed Jan. 25, 1896. An armature winding for a dynamoelectric machine, in the form of an armature cloth, the conductors in said cloth being applied to the armature-core in a spiral direction.

558,028. SIGNALING SYSTEM FOR ELECTRIC RAILWAYS; F. Bathurst, Schenectady, N. Y. App. filed July 15, 1893. In a signaling system for an electric railway, the combination of two switches situated at either end of a section of track, and operated by a car traveling thereon, indicating and block lights operated by the switch, the indicating lights indicating at one point only, the block lights at two.

558,031. SAFETY DEVICE FOR ALTERNATING SYSTEMS; E. J. Berg, Schenectady, N. Y. App. filed Oct. 5, 1895. In an alternating electric power system power lines supplying polyphase currents, a motor actuated by such supply lines, and means for supplying to the motor an E. M. F. of phase displaced from that of either of the lines, such means operated by a failure of current from one of the supply lines.

558,033. ELECTRIC RAILWAY SYSTEM; H. M. Brinckerhoff, Chicago, Ill. App. filed June 13, 1895. In an electric-railway system, wherein are employed two or more independent sections of road, and an independent working conductor for each section, and as a means for bridging the space between the meeting end of working conductors for successive sections of road, an auxiliary conductor at least equal in length to the distance between contracts carried on opposite sides of a car, and means for supplying said auxiliary conductor with current.

558,042. AUTOMATIC TELEGRAPH REPEATER; A. E. Collyer, Monmouth, Ill. App. filed Dec. 26, 1893. In an automatic telegraph repeater, a tubular socket, an upright stem rotatably mounted therein, a bar pivoted to the stem, and an electromagnet for rocking said bar on its pivot when the stem is turned to one position.

558,045. METHOD OF AGING PERMANENT MAGNETS; F. P. Cox, Lynn, Mass. App. filed Feb. 21, 1896. The method of aging magnets, which consists in reducing the flux in the magnet and causing the flux remaining therein to be permanent, by cutting the lines of force in the magnet through the revolution of an electrical conductor in the field of said magnet.

558,090. TRANSFORMER AND METHOD OF COOLING SAME; W. S. Moody, Lynn, Mass. App. filed Jan. 17, 1896. In a transformer, the combination of coils of wire surrounded by an iron core, and an insulating medium flowing down the outside of the core in a film.

558,091. BATTERY; W. Morison, Montclair, N. J. App. filed May 8, 1894. A battery consisting of a closed containing-vessel constructed of electrically non-conducting material, provided with a circuit-wire system embedded in the material forming the battery-case, an opening through one end of said vessel into the interior compartment, for the introduction of an electrode, provided with a lining electrically connected with the said wire system, and an anode and cathode in said compartment.

558,104. REGULATING INDUCTION MOTOR; W. B. Potter, Schenectady, N. Y. App. filed Jan. 15, 1896. The method of regulating alternating-current motors of the induction type, which consists in connecting the fields permanently in multiple between the supply-lines, closing the circuits of the armatures through separate simultaneously variable resistances, and varying the resistances to regulate the speed of the motors.

558,106. CONNECTION FOR TELEPHONE APPARATUS; P. Rabbridge, Sydney, New South Wales. App. filed May 20, 1895. A telephone apparatus, comprising two conductors, one of which is permanent, the transmitters and receivers arranged in the closed circuit formed by said permanent conductor, the other conductor being arranged in shunt with the receiver and transmitter and arranged to be broken, the said receivers being arranged to make and break the shunt circuit, the call bells in said shunt-conductors and the pole-changers in the permanent circuit.

558,109. AUTOMATIC CUT-OUT AND RESISTANCE REGULATOR; E. B. W. Reichel, Gross-Lichterfelde, Germany. App. filed Dec. 27, 1895. In a combined resistance regulator and cut-out, the combination with a pair of contacts between which an arc is adapted to be formed upon the separation of the contacts, of an electric circuit to be controlled in which circuit said contacts are included in series, a solenoid or electromagnetic coil included in saidcircuit responsive to changes of current strength therein, and arranged to separate said contacts to a greater or less extent to introduce a resistance into the circuit proportional to the current strength, and means for permanently separating the said contacts upon the passage of a current of a predetermined maximum value to permanently open the circuit, whereby variations of current strength below the predetermined maximum are compensated for by the introduction of an arc resistance, while the circuit is permanently opened when the current strength exceeds the predetermined maximum

558,110. ELECTRIC RAILWAY; L. W. Reid, Mound, Tex. App. filed Aug. 8, 1895. In an underground trolley, a rod pivoted to a block beneath the car, a collar slidably on the lower end of said rod, a guide-wheel journaled to arms of the collar, an arm attached to the side of the collar, a trolley-wheel on the arm, a spring-pressed collar bearing against said trolley-wheel, a feed-wire attached to and insulated from the top of the conduit, a rail forming one wall of the conduit, a foundation for the wall extending within the conduit and having a slot forming a way for the guide-wheel, and means for draining said slot.

558,119 REGULATING ALTERNATING-CURRENT MOTORS; C. P. Steinmetz and E. J. Berg, Schenectady, N. Y. App. filed Dec. 26, 1895. In combination, a single-phase electric railway comprising outgoing and returning conductors, a traveling vehicle making contact with such conductors, transformers upon the vehicle having their primaries connected in series, and their secondaries in reversed relation to one another, and polyphase motors taking current from the transformers.

558,120. COMMUTATOR; D. P. Thomson and A. R. Geranson, Schenectady, N. Y. App. filed Dec. 19, 1895. An automatic ventilating-commutator constructed with a radial fan and air passages leading from the interior of the commutator to the exterior thereof adjacent to its periphery, whereby a forced circulation of air is maintained through the commutator.

558,122. INCANDESCENT LAMP; K. O. E. Trobach, Pankow, Germany. App. filed April 18, 1804. An electric lamp comprising a bell-shaped incandescing body of flexible and spongy carbon, and circuit terminals connected therewith.

558,151. ELECTRIC RAILWAY SYSTEM; W. M. Brown, Johnstown, Penn. App. filed Nov. 29, 1895. In a contact box, a cover containing two magnetic conductors magnetically separated from each other and having a recess or cavity in its lower face into which cavity the member to be magnetically influenced is adapted to enter.

558,153. ELECTRICALLY ACTUATED DENTAL PLUGGER; A. W. Browne, Prince's Bay, N. Y. App. filed Nov. 6, 1895. In an electrically actuated dental plugger, a supporting frame consisting of a tubular portion to receive the plugger-handle, and end pieces detachably secured to the tubular portion to receive the magnets between them.

558,165. ELECTRIC WIRE CLEAT; B. B. Evans, Clinton, Mass. App. filed Aug. 26, 1895. A wiring-cleat made in two similar and interchangeable parts, said parts having interlocking faces substantially perpendicular to the base of the cleat and at right angles to the wire-passages.

558,167. TELEPHONE SERVICE REGISTER; S. D. Field, Stockbridge, Mass. App. filed Aug. 21, 1895. The combination with a lever whose position is altered during the use of the telephone transmitter or receiver, of registering mechanism, a link adapted to connect the lever with the said mechanism to communicate motion thereto, and a device controlling a signal sending circuit, said device being adapted when actuated to bring said link into operative connection with the lever.

558,168. CALL COUNTER FOR TELEPHONES; S. D. Field, Stockbridge Mass. App. filed Aug. 21, 1895. In a telephone-service register, the combination with recording mechanism and means for actuating the same, set into operation by a movement of the telephone apparatus, an interposed link normally in a non-operative position, for connecting said recording mechanism with its actuating means, and means for retarding the movement of said link from its operative to its inoperative or normal position.

558,184. CARBON BRUSH HOLDER FOR ELECTRIC MACHINES; W. E. Knowlton, Portland, Me. App. filed Feb. 19, 1896. A carbon brush-holder for electric machines, consisting of a socket for holding the brush on end against the commutator, a clamp secured to the brush-holder stud, bars or rods connecting said socket with said clamp, and a spring pivoted by one end to said clamp, the opposite end bearing on the outer end of said brush to press the same against the commutator.

558,238. ELECTRIC RAILWAY; H. L. Tyler, Corning, N. Y. App. filed July 11, 1894. A system of alternating-current electric locomotion comprising a working circuit composed of track rails, a plurality of transformers connected in multiple arc with said working circuit, and a primary inducing-circuit charged with alternating currents of high potential and composed of an independent insulated outgoing conductor, and a return-leg formed by one side of the track or working circuit.

558,239. ALTERNATING-CURRENT MOTOR; H. L. Tyler, Corning, N. Y. App filed July 19, 1894. In an electric transmission of power system the combination of a source of supply of alternating currents, a circuit con-

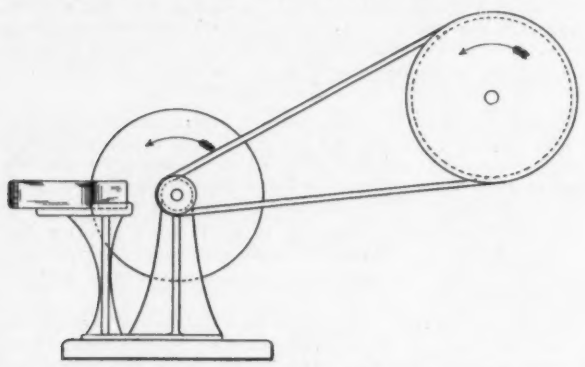
nected therewith, a synchronous electric motor, circuit connections whereby a non-synchronous motor brings the synchronous motor up to synchronism, a second coil on the armature of the non-synchronous motor and in inductive relation to the armature-coil thereof, and means whereby the alternating current is switched into the synchronous motor, and said second coil, when synchronism is reached, thereby converting the non-synchronous motor into a revolving transformer.

558,252. RHEOSTAT PLATE; J. P. Ball, Philadelphia, Pa. App. filed Jan. 27, 1896. A rheostat or resistance plate having grooves, in combination with a resistance wire bent upon itself to form a convolute, and held in place within the grooves by compression against the walls thereof.

558,256. ELECTRICALLY OPERATED MEANS FOR CONTROLLING VALVES; C. M. Bush, Bristol, Conn. App. filed Jan. 24, 1895. A device comprising a magnet having its pole-faces arranged in a common plane and longitudinally of its field of force, an oscillatory armature adapted to move in and longitudinally of the field of said magnet, said armature projecting normally into the portion of the field of greatest intensity and means for transmitting motion from said armature.

558,283. UNDERGROUND SYSTEM FOR ELECTRIC RAILWAYS; A. S. Krotz, Springfield, O., and W. P. Allen, Chicago, Ill. App. filed Aug. 23, 1895. In an underground system, a series of sectional tubes or enclosing casings, a conductor extending through all of said tubes or casings of the series, contacting devices supported on said tubes or casings, and a connection from said conductor to each of said contacting devices, said connections being made inside said tubes or casings.

558,284. CONDUIT OR SUBWAY FOR ELECTRIC RAILWAYS; A. S. Krotz, Springfield, O., and W. P. Allen, Chicago, Ill. App. filed Dec 2, 1895. In a subway or conduit a series of supports connected to the walls of said subway or conduit by insulators, said supports being connected to and adapted to sustain contacting rails and feed-wires or conductors, said contacting rails and feed-wires or conductors being each insulated one from the other and from said supports and a detachable connection from one or more of said feed-wires or conductors to the contacting rails.



No. 558,045.—Method of Aging Permanent Magnets.

558,299. PUSH BUTTON SWITCH; H. E. Nickerson, Cambridge, Mass. App. filed Dec. 7, 1895. A latch-plate having a flange and a tongue at opposite points of its periphery, in combination with a pair of fixed catches adapted to engage with said tongue at the two extreme positions of the latter, a cam-plate arranged to act on the said flange to free said tongue from such engagement, means for giving axial motion to said cam-plate at will, a retracting spring for the said latch-plate and contacts operated by the latter to make or break the circuit, the said spring turning on the said latch-plate when the latter is freed as aforesaid, and the opening or closing of the circuit being determined by one or the other extreme axial position of the said latch-plate.

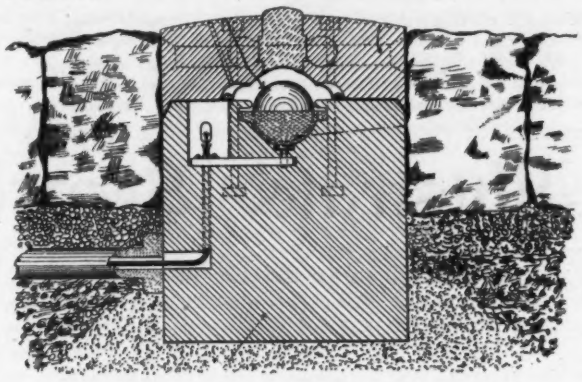
558,303. ELECTRIC RAILWAY; D. N. Osyor, Newark, O. App. filed Jan. 23, 1889. In an electric railway system, a main track, a branch track having a movable switch, an electromagnet having an armature connected to said switch, a curved contact-spring electrically connected with said magnet, and a pressure wheel mounted on a car and adapted to press said spring against said contact-point whereby said magnet is energized.

558,310. APPARATUS FOR COMPOSITE TRANSMISSION OF INTELLIGENCE; F. A. Pickernell, Newark, N. J. App. filed Oct. 17, 1894. In a system for the simultaneous transmission of telegraphic and telephonic messages, as herein set forth in which the telephonic circuit is composed of two main conductors with branch continuations through condensers at each terminal and provided with receiving and transmitting telephonic apparatus, means for preventing induced telegraphic currents from disturbing the telephonic signaling circuit, consisting of one or more ground branches from the said circuit with which are included alternatively-electromagnetic retardation-coils or equivalent differentially-wound signal instrument-winding.

558,313. TELEPHONE TRANSMITTER; A. W. Rose, New York, N. Y. App. filed Aug. 29, 1895. In a telephone, a diaphragm, electrodes having a vibratory relation with each other, comminuted carbon mounted between said electrodes and sloping flexible walls arranged at an angle to the direction of such vibration.

558,322. ELECTRIC RAILWAY; C. F. P. Stenderbach, Leipsic, Germany. App. filed March 7, 1895. An electric railway with underground conductor composed of a pair of guard-rails, a contact-rail, a case, cover, inner cylinder, a mercury seal at the bottom of such cylinder, an insulated contact pin and a contact within the cylinder, all being so constructed that contact is made between the underground conductor and the contact rail by a depression of the latter.

558,343. ELECTRIC SWITCH; C. G. Bergquist, Chicago, Ill. App. filed June 25, 1895. In a switch the combination of a body having a dovetailed groove and a flattened surface, a shaft mounted to turn in said body and projecting therefrom at right angles to said flattened surface, insulated contact points on the body, a switch arm on the shaft to engage said contact points, a ratchet wheel on the shaft, and a spring having a shank to engage said dovetailed groove in the body and arranged to engage the teeth of said ratchet wheel.



No. 558,151.—Electric Railway System.

558,354. TELEPHONE TRANSMITTER; W. R. Cole, Detroit, Mich. App. filed May 15, 1894. In a telephone transmitter, a suspended oscillatory electromagnet in the circuit of the transmitter and carrying the outer electrode.

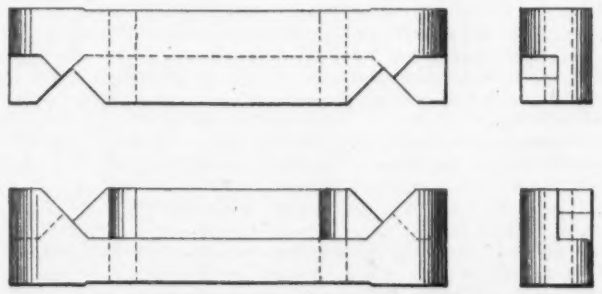
558,362. ELECTRIC RHEOSTAT; F. H. Doane, Newton, Mass. App. filed Sept. 30, 1895. In a rheostat, the combination of a metallic holding-strip electrically connected with the external circuit, a plurality of graphite bars held by said strip, one or more electrical connections from each of said bars to suitable contact terminals, and a movable arm arranged to make contact with the said terminals successively, said arm being also connected with the external circuit.

558,385. TELEPHONE BELL; R. D. Harrigan, Leadville, Col. App. filed Nov. 5, 1895. In a telephone, a gong, a hammer therefor, a main electric circuit for operating the hammer, an auxiliary circuit comprising a battery, wires connected with the main circuit wires and contact points, and a closer for said auxiliary circuit, comprising a lever having its members arranged substantially at right angles to each other, one of the members being provided with contact points to engage the contact points of said auxiliary circuit, and the other member adapted to be engaged by the hammer.

558,429. TROLLEY ATTACHMENT FOR ELECTRIC CARS; R. Skeen, Madison, Ill. App. filed Sept. 9, 1895. In combination with a trolley, a mechanism placed in an electric circuit with the trolley and adapted to check the upward movement of the trolley when the latter is disengaged from the trolley wire.

558,450. ELECTRIC MINE CAGE AND ELEVATOR; C. J. Cutler, Butte, Mont. App. filed June 26, 1895. The combination with a elevator cage of a vertical lever fulcrumed in the motor-supporting frame, and extending up through the platform within reach of the operator, and plungers movably secured in guides on the under side of said motor-supporting frame, their inner ends connecting with the lever on opposite sides of its fulcrum whereby they are adapted to be thrust outwardly and engage recesses or stops in the sides of the elevator-shaft.

558,453. TEMPERATURE REGULATOR; H. Gillette, Highland Park, Ill. App. filed July 19, 1895. A thermostat having a split blade, with a long and short tail, and four contact pieces, two for the long tail and two for the short tail, in combination with a shaft connected to the valve or damper, two trains of clockwork geared to said shaft for revolving it in opposite directions and adapted to turn said shaft, such distance at one time as shall move the damper through half its arc, an electromagnet and armature for each of said trains, adapted to release the train when the magnet is operated, and the electric circuits controlled by the thermostat and by moving contacts mounted on said shaft.



No. 558,165.—Electric Wire Cleat.

558,465. ELECTRICAL HAIR CUTTER AND SINGER; F. M. Bell, New York, N. Y. App. filed March 22, 1895. In an electric hair cutter and singer, and combination with a hair support of a wire or bar of refractory material held by the support.